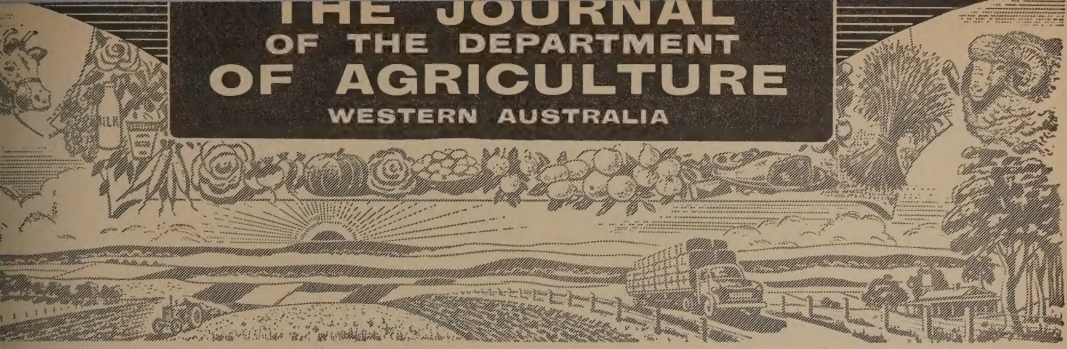
THE JOURNAL
OF THE DEPARTMENT
OF AGRICULTURE
WESTERN AUSTRALIA



VOL. 1 (Fourth Series) NOVEMBER, 1960 No. 11

Issued by direction of the Minister for Agriculture, and published monthly by the Department of Agriculture, Perth, Western Australia.

Annual Subscription Rates (inclusive of postage) are:—
Australia and New Zealand .... 20s.
Other British Commonwealth Countries .... 23s.
Foreign Countries 29s.
Single copies, 2s. each.

Articles which appear in the Journal may be reprinted, provided that both the Journal and the authors are acknowledged.

COVER PICTURE
"Toolbrunup" in the Stirling Ranges. This spelling of the name is from the native sound of it as heard by Ensign Dale in 1832

In this Issue

	Page
Soil Conservation in the Kimberley Area of Western Australia .... K. Fitzgerald	949
"Toolbrunup"	956
Registered Stock Foods, 1960-61	958
Tobacco Production in Western Australia .... A. E. Baker	961
Fruit Fly Control with Rogor 40 and Lebaycid .... D. Shedley	973
Sclerotinia Rot of Beans .... S. C. Chambers and M. Hardie	977
Leaf Scorching	983
Geranium Rust	987
Bulk Handling of Superphosphate .... H. G. Cariss	991
Facts and Figures .... J. A. Mallett	997
Farm and Home—Lamb for Good Living .... Helen M. Gloster	1005
Milk Fever (Hypocalcaemia) of Cows	1009
Honey Flora Calendar for December	1014
Bitterpit .... F. Melville and S. E. Hardisty	1017
Lupinosis in Sheep—	
Laboratory Studies .... M. R. Gardiner and M. C. Nottle	1021
Field Studies .... M. R. Gardiner and A. W. Williams	1025
Tractor Testing in Australia .... G. H. Vasey and W. F. Baillie	1029
Books for Farmers	1037
Australian Spark Arrester Tests—International A.W.7	1039

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SOIL CONSERVATION

In the Kimberley Area of Western Australia

By K. FITZGERALD, B.Sc. (Agric.), Agricultural Adviser, Kimberley Area

OFFICERS of the Soil Conservation Branch of the West Australian Department of Agriculture, have not been engaged in soil conservation work in the Kimberleys prior to this year, not because a serious erosion problem did not exist, but rather because with limited trained staff available they were too fully occupied elsewhere. The recent arrival of a senior Soil Conservation Officer in the area to assist and plan an approach to the problem of soil erosion in the Ord River catchment area is therefore very welcome.

In the meantime, officers of the North-West Branch and the author in particular, have been actively engaged in attempting to revegetate eaten out and degraded country in an effort to reduce water run-off, increase water penetration and so reduce soil erosion.

NATURE AND EXTENT OF THE PROBLEM

Soil erosion problems exist in both the East and West Kimberley areas, reaching maximum severity in the vicinity of the major river systems, the Ord River and its tributaries in the East Kimberley and the Fitzroy, with its major tributaries in the West Kimberley.

Being primarily a pastoral area, with an industry based for the most part on open-range conditions, utilising natural waters, degradation, denudation and consequent soil erosion have been generally confined to areas adjacent to the river systems and closely parallel the use, or abuse, to which they have been subjected.

This does not imply that the grazing animal has been the sole causal agent; geological formation and soil type, seasonal incidence and severity of rainfall, droughts, fires, wind and a lack of knowledge on the part of the pastoralist, have all played their part.

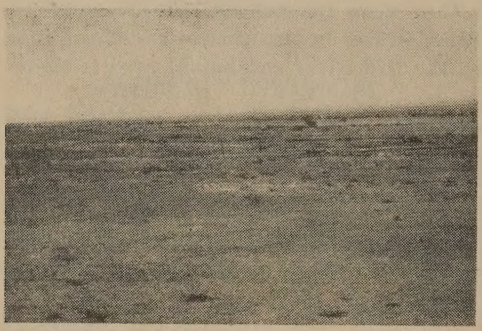
The type of erosion varies from area to area; from soil type to soil type, but all forms, including gully, sheet, stream bank and stream bed erosion are represented.

Soil erosion, both sheet and gully, reaches its greatest magnitude and intensity in the Ord River catchment area of East Kimberley, where an area of approximately 1,100 square miles, covering the cattle stations Ord River, Mistake Creek and Turner Station has been devastated. Degradation ranges from partial to com-

Bare country, Turner Station, East Kimberley

plete denudation. Grass cover, where it remains, is of the inferior annual species *Enneapogon, Sporobolus* and *Aristida,* except on the limestone ridges where *Triodea* species remain, and in the heavier-textured soils in some of the valleys and depressions where mixed *Astrebla, Dichanthium* and *Iseilema* species still persist.

The soils in this area are formed over Upper Cambrian flaggy limestones and mudstones that have weathered into fine powdery soils prone to both wind and water erosion. The country is gently undulating, with an occasional limestone outcrop; is almost devoid of trees except on the stream lines, and is highly dissected with shallow but steep-sided creeks, gullies and rivers. Dead trees with a "perched" layer of roots 9 to 12 in. above present ground level indicate the severity of sheet erosion by both



Denuded country actively gulleying on Order River Station, East Kimberley

wind and water. The area is prone to severe dust storms. A glance at a map or aerial photograph of the area confirms the severity of gully erosion.

Erosion of the levee banks appears less severe in the East Kimberleys than in the West. In the former it appears in the form of deeply-incised creeks cutting through the levee soils, usually at right angles to the river which it joins. In the West Kimberleys, particularly along the Margaret and Fitzroy Rivers, the levee soils are better developed and open out into fairly broad flats, usually well above the level of the floodplains. As such they have suffered severe degradation and denudation and are crossed by deep creeks and give evidence of severe sheet erosion. Some 70,000 to 80,000 acres of valuable levee country was mapped along the Margaret River frontage east of Fitzroy Crossing and described as badly degraded.

Severe floodplain erosion has occurred along the lower Fitzroy River from Fitzroy Crossing to its mouth near Derby, a distance of roughly 160 miles, the Margaret River and Christmas Creek. Damage is both in the form of gullies and sheet erosion.

Erosion on the fine-textured floodplain soils has been aggravated by the presence of a stock route along the section cited. The surface has powdered under the action of countless hooves and has either blown or washed away.

Very extensive areas of semi-flood plain country occur adjacent to the Fitzroy River; these are fine textured soils similar to Red Brown Earths and have solonetzic tendencies. Every four or five years these areas are flooded and this, coupled with excessive grazing, has produced an almost pure stand of annual species. *Trianthema* (Miniature Pig Weed) and *Zerochloa* sp. (Rice Grass). This country erodes readily and has suffered severe gullying and sheet erosion.

Claypan formation has proved troublesome and difficult to deal with especially in the West Kimberleys.

The very fine-texured soils adjacent to the Margaret River and Christmas Creek, appear prone to claypan formation and the same areas have suffered excessive trampling. These bare, windswept and glazed surfaces are completely impervious to water and through run-off have produced gullies along their erodable fringes.

The term "Pindan" is loosely applied to red sandy soils with a characteristic vegetative cover of scrubby wattle (*Acacia* sp.) and mixed *Triodea pungens, Plectrachne pungens, Chrysopogon* and *Aristida* species. The more extensive areas in the West Kimberleys are characterised by stabilised dunes. However, in certain areas south of the Fitzroy River, where rainfall is marginal, shifting dunes are to be seen. Flowing bores and natural springs have induced heavy concentrations of stock onto these marginal areas, thus reducing the original sparse vegetative cover and assisting the sand drift.

Saltpans of limited extent are to be found in the same area. Some have been colonised by the salt tolerant Paspalum

species but for the most part they are bare and uninviting.

CONTROL MEASURES

To date, all remedial measures have been directed towards re-establishing vegetation in the hope of reducing run-off and erosion. Both grazing control and cultural treatments have been employed.

Specific examples will indicate the nature of the problem and the control measures taken.

1.—Levee Soils.

Along the Margaret River frontage near Fitzroy Crossing, the broad levee soils have been degraded and denuded under pressure of heavy and continuous grazing. Both sheet and gully erosion are in evidence with claypans forming around the watering points.

Four years ago some 800 acres of the worst-affected country was fenced to exclude stock and subjected to a range of cultural treatments involving both strip and checkerboard ploughing at varying intervals both with and without reseeding. Ploughing was done with a twin-disc plough and the banks and furrows reseeded with mixed Buffel grass (*Cenchrus ciliaris*), Birdwood (*Cenchrus setigerus*) and Kapok Bush (*Aerva javanica*).

In the second and subsequent years the areas were lightly grazed, after seed-fall, to help break up the ground between the furrows and to trample in the seed.

Spectacular results have been achieved and with about a 50 per cent. ground cover, composed largely of perennial species, both native and introduced, the area will now be used as a grazing management demonstration. One half of the area will be grazed continuously while the other half will be grazed on a Deferred Rotational system to show that bare country can be revegetated and maintained at a high level of productivity by careful management, but if handled incorrectly carrying capacity will be lower and productivity will decline.

2.—Semi-floodplain Country.

An area of 2,500 acres of bare, windswept semi-flood plain country near the Cherrabun Station homestead adjacent to the Fitzroy River, was fenced in 1956 and subjected to remedial treatment. This country originally carried a mixed *Astrebla*, *Iseilema* and *Zerochloa* cover but had been bare for 12 to 14 years, and as such was an erosion hazard.

The soils closely resembled Red Brown Earths and when wetted behave like sodium clays, making them difficult to work and handle.

A wide range of implements and cultural techniques were tried out with the net result that an interesting plant succession was initiated and has persisted. All attempts to establish introductions have failed and all banks and furrows have dissolved.

In the first season of treatment the annual species *Sporobolus* and *Trianthema* consistently established along and only along the furrows, but in the second season spread between the furrows while *Zerochloa* (Rice grass) established in the old furrows. By the third season Rice grass had spread between the furrows and *Iseilema* had appeared in the furrows. In the fourth season *Iseilema* and Rice grass were widespread, with an occasional *Astrebla* plant putting in an appearance.

A good response to furrowing, seeding and deferred grazing on Ord River Station, East Kimberley

A plant succession of this nature is not uncommon and is probably due to better water penetration with the furrows and a gradual soil texture and fertility build-up. The time now seems ripe to introduce more productive perennial species into the existing cover.

Run-off from the once bare area has been reduced and wind erosion is now almost non-existent.

3.—Claypan Reclamation.

Along both the north and south sides of Christmas Creek, claypans up to half

a mile wide and many miles long have been produced under the combined action of overgrazing, excessive trampling, wind and water scouring.

In their bare, glazed and impervious condition, prior to the first storms, heavy rippers, mouldboard or disc ploughs make no impression on the surface, but if left until after the first storms, the ground can be scratched to a depth of ¾ to 1 in. This is sufficient to allow water to penetrate and by re-opening along the old lines, say in April, a penetration of up to 8 or 9 in. can be achieved.

Native annual species *Cleome viscosa, Enneapogon* sp. and *Brachiachne* sp. can be established along these furrows and, as windborne sand collects against the obstructions, new soil is formed and the introductions Buffel and Birdwood can be established.

Protection from grazing is essential during these formative years.

Workers checking the depth of water penetration in the furrows. This gives some idea of the bare conditions of the Cherrabun Plain

4.—Water Spreading and Contour Ripping.

Some interesting conservation work is going on at Calwynyardah Station some 110 miles East of Derby. The owner alarmed at the decline in his vegetative cover and noting the amount of water running off his country and the short duration of flow in the creeks, has constructed a series of banks across some of them in an effort to halt the flow of water, build up water behind these banks and spread it over the nearby country.

This water-spreading, coupled with reseeding has successfully re-established vegetation along the once bare creek banks and adjacent flats. It has successfully slowed down the flow of water in the creek and provided excellent stock waters.

Elsewhere on the property contour ripping with a D4 and three-pronged ripper has been carried out along the gravelly and shaley ridges and nearby Yellow Earth slopes and flats, in an effort to reduce water run-off and increase penetration. The system is successful but could be uneconomical.

A Department trial is being conducted to see whether the same results can be obtained using lighter and less expensive equipment.

5.—Large Scale Regeneration Trials—West Kimberleys.

An area of 200 square miles on Cherrabun Station, immediately south of Christmas Creek, has been selected as representing the worst forms of sheet erosion, gullying, claypan, saltpan and sand-dune formation in the West Kimberley, and has been fenced and subjected to remedial treatment.

Removal or reduction of grazing pressure was a first consideration and this has only just been achieved with the completion of some 60 miles of new fencing.

In the meantime some 1,600 miles of furrows have been ploughed and reseeded using mixed Buffel, Birdwood and Kapok Bush seed. The furrows were roughly five chains apart giving coverage over some 100 square miles.

Initial response to protection and a good season are encouraging but so far the introductions have not been very promising.

Further furrowing and reseeding are planned for this season including an attempt to establish *Kochia brevifolia* on the saltpans.

Inspecting regenerated grass cover on formerly bare aerodrome paddock, Cherrabun Station

6.—Ord River Catchment Area — East Kimberleys.

As mentioned earlier, soil erosion, both sheet and gully, reaches its maximum extent and severity in this area with some 1,100 square miles mapped and described as bare, eroded or windswept with degradation ranging from partial to complete denudation.

Extension officers of the West Australian Department of Agriculture have been experimenting at Ord River Station for three or four years testing various techniques for the large-scale re-establishment of vegetative cover in this critical area, in an effort to reduce possible siltation in the proposed Ord River dam.

A recent Government decision to revegetate the catchment area has focused attention on the nature of the problem and on the methods to be adopted.

Basically the proposals call for the progressive fencing and reseeding of the entire eroded and denuded area, the work to be carried out over a period of years.

Fencing is essential to ensure protection from grazing in the establishment years and to facilitate controlled stocking to assist establishment and spread in later years. Paddocks will make possible a system of Deferred Rotational grazing which should ensure a self-regenerating, healthy and productive pasture.

Experience has shown that reseeding with perennials is necessary because even in areas protected for three or four years native perennial species have not reappeared amongst the annuals, obviously because supplies of seed of perennials have been depleted. Annual species do not provide satisfactory ground cover in a catchment area.

It has been shown that all three types, Buffel, Birdwood and Kapok can be established on these calcareous soils if strip cultivation is done. Owing to the bareness of the country and the degree of slope, all work must be done on or near the contour; this will make the project slow and tedious.

In the initial stages work will be confined to the tops and upper slopes of all the major ridges. One-foot contours are being established down the slope stopping at the commencement of the gullies. Later on some work will be done between the gullies.

Intensity of rainfall and severity of sheet run-off poses a danger to the erection of contour banks, hence it is proposed to deeply rip the accurately surveyed one-foot contours, using a three-pronged chisel plough. Again, with some 200 square miles to be treated each year and most of it requiring some attention, it will not be practical to accurately survey every cultivated line, consequently discontinuous ripping or ploughing will be done between the accurate contour rippings. By lifting the machine out for say five yards in every 25 yards the tendency to run water should be reduced. Again every second run will cover the gap in the previous one.

A wide range of implements is available for use in the area but it is expected that the three- or five-pointed chisel plough and a "Basin-Lister" type of plough in which the "cut-away" discs are opposed to each other, should do the bulk of the work. Conventional twin-disc ploughs and an unorthodox twin-disc with the discs "opposed" to each other will be used where banks are required.

Seed boxes have been specially designed for mounting on to the tractor behind the driver's seat and are chain-driven from a sprocket on the hub of the tractor wheel. These have a capacity of about 15 lb. weight of mixed Buffel and Kapok seed, or sufficient to seed about 10 to 12 miles of furrows.

Running of the contour lines will be the slowest and most tedious part of the operation but some "speedy" methods are being tested. The use of painted targets clamped to the staff facilitates reading without reference to actual numbers and enables one instrument man to work two staffs without great effort.

Larger type targets attached to the backs of vehicles or tractors and sighted through a dumpy level make possible fast contouring, the tractor driver being guided through radio control from the level operator. Average deviations of about 1½ in. in 100 ft. seem possible and with discontinuous furrows or ripping should be quite satisfactory.

Tractor mounted contour meters have not proved satisfactory being too sensitive to bumps and changes of speed.

For a project of this size adequate supplies of suitable seed at a reasonable price, must be available. Buffel, Birdwood and Kapok fill these requirements and, as they favour calcareous soils, should do well. The tussock forming habit and their massive rooting system make Buffel and Birdwood ideal for soil erosion control.

Finally a team of keen, experienced and enthusiastic operators must be available. They should be fully equipped, mobile and self-contained and ready to cope with the problems, difficulties and discomfitures associated with projects of this nature.

"TOOLBRUNUP"

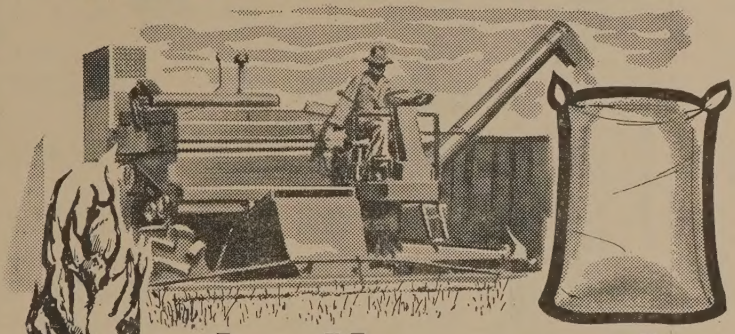
Our cover picture shows one of the many sights to greet the traveller within our State. Toolbrunup, one of the highest peaks of the Stirling Range, is approximately 45 miles north of Albany and 28 miles north-east of Mt. Barker.

At the request of the Governor of the day, Captain James Stirling, Ensign Dale explored this area in January, 1832. He knew the "hill" as Tood-ve-rup and it was after a two days walk from Albany that he came within three miles of its base. The following morning at daybreak he covered the extra distance, and after a two hours climb mounted the summit which he thought was about 3,000 feet above sea level. Survey has since shown it to be 3,341 feet.

For him it was a peak from which to view and make note of the surrounding features. Two particular notes he made in his report were the fresh water he found at the base, a change from the brackish water he had been forced to drink on the trip, and that there he met natives of the White Cockatoo and Will tribe, who called the mount "Tool-brun-up," the name which now survives.

"Ceresan" Dry-seed Pickle

more bushels . . .



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Registered Stock Foods 1960-61

(Supplementary List)

Stock Food	App. No.	Brand	By whom registered	Materials from which made	Registered Analysis						
					Crude Protein	Crude Fat	Crude Fibre	Sodium Chloride (NaCl)	Phosphoric Acid (P_2O_5)	Calcium (Ca)	Percentages of other substances claimed to be of reputed Medicinal or Nutritive Value
					(Min.) %	(Max.) (Min.) %	(Max.) %	(Max.) (Min.) %	(Max.) (Min.) %	(Max.) (Min.) %	%
A.—Simple Foods											
1.—Meat Meals											
Meat Meal	317	Wesfarmers Hi-Efficiency	Westralian Farmers Co-op. Ltd.	Meats, bones, fats, offals	37·0	12·0 8·0	2·0	4·5 0·5	17·0 14·0	15·0 12·0	
3.—Whale Meals											
Whale Meal 60%	315	N.W.W.	Nor-West Whaling Co.	Humpback whales	60·0	5·0	1·0	1·5 0·5	10·0 7·0	11·0 8·0	
Whale Meal 62%	310	do.	do. do. do.	do.	62·0	5·0	1·0	1·5 0·5	10·0 7·0	11·0 8·0	
Whale Meal 66%	316	do.	do. do. do.	do.	66·0	5·0	1·0	1·5 0·5	10·0 7·0	11·0 8·0	
5.—Fish Meals											
Cray Meal	281	Sea Breeze	Fremantle Fishermen's Co-op.	Crayfish offal	40·3	10·6	....	....	.... 4·93	.... 10·51	
7.—Yeast Products											
Brewer's Dried Yeast Extract	323	Sanco	Sanitarium Health Food Co.	Brewer's Yeast	37·0	2·0	5·0	5·0	....	....	
B.—Compound Foods											
7.—Dog Foods											
Dog and Cat Food	311	Dine-A	Hunts Canning Co.	Fish, wheat meal, salt	21·4	5·0 3·0	0·7	1·7 1·5	3·7 3·0	3·3 2·7	
Dog Food	312	Pets	Processed Meats Pty. Ltd.	Wheat, rice, meat, liver, bone, cod liver oil	8·0	7·0 4·0	1·0	0·4			
Dog and Cat Food	313	do.	do. do. do.	Wheat, rice, fish, bone, meat, cod liver oil	8·0	7·0 4·0	1·0	0·4			
Dog Bone	314	Swallows	Swallows Biscuits Pty. Ltd.	Flour, fat, ground biscuit meal, salt, bicarbonate of soda	14·0	13·0 5·0	3·0	1·8 1·4	0·2 0·1	0·5 0·2	
4.—Poultry Foods											
Chick Starter Mash	307	Bairds	Bairds Pty. Ltd.	Pollard, meat meal, wheat meal, bone meal, shellgrit, salt, riboflavin, emulsified fish oil	17·0	4·0 3·5	5·0	1·0 0·75	3·0 2·5	3·5 2·5	Manganese sulphate 0·0125
Growing Mash	308	do.	do. do.	Bran, pollard, meat meal, wheat meal, bone meal, shellgrit, salt, riboflavin, emulsified fish oil	15·0	4·0 3·5	5·0	1·0 0·75	3·0 2·5	3·5 2·5	do. do.
Laying Mash	309	do.	do. do.	Bran, pollard, meat meal, wheat meal, bone meal, shellgrit, salt	17·0	4·0 3·5	5·0	1·0 0·75	3·0 2·5	3·5 2·5	

Vitaminised 16% Chick Starter	318	Richfoods	A Richards & Co.	Meat meal, buttermilk, bran, pollard, wheat meal, oat meal, yeast, bone meal, ribon, mineralised vitamins A and D_3	16·0	5·0 3·0	7·0	1·0	3·0 1·0	3·0 0·8	Vitamin A 2,000 I.U./lb Vitamin D_3 500 I.U./lb.	
Vitaminised 15% Growers Mash	319	do.	do do.	Wheat meal, meat meal, whale meal, bran, pollard, oat meal, bone meal, mineralised vitamins A and D_3	15·0	5·0 3·0	7·0	1·0 ¼	3·0 1·0	3·0 0·8	do.	do.
16% Laying Mash	320	do.	do. do.	Wheat meal, meat meal, whale meal, bran, pollard, oat meal, oyster flour, bone meal	16·0	6·0 4·0	7·0	1·0	3·5 2·3	2·5 2·0		
Vitaminised 16% Laymash	321	do.	do. do.	Bone meal, oyster flour, bran, pollard, oat meal wheat meal, meat meal, whale meal	16·0	6·0 4·0	7·0	1·0	3·5 2·3	2·5 2·0	do.	do
Vitaminised 20% Laymash	322	do.	do. do.	Wheat meal, meat meal, whale meal, bran, pollard, oyster flour, bone meal, oat meal	20·0	10·0 6·0	7·0	1·0	4·0 1·0	3·5 1·5	do.	do.
18% Cockerel Fattening Pellets	324	Thomas	W. Thomas & Co	Grain meals, bran pollard, wheat germ, meat meal, whale meal, lucerne meals, milk powder, Christmas phos, oyster flour, salts, manganese sulphate, vitamins A and D_3	18·0	2·0	6·0	1·0 0·5	3·5 1·0	3·75 1·0	Vitamin A 6,000,000 I.U./ton Vitamin D_3 1,800,000 I.U./ton	
18% Cockerel Fattening Mash	327	do.	do. do.	do. do. do.	18·0	2·0	6·0	1·0 0·5	3·5 1·0	3·75 1·0	do.	do.
18% Cockerel Starter Crumbles	326	do.	do. do.	Grain meals, bran, pollard, wheat germ, meat meal, milk powder, lucerne meal, bone flour, oyster flour, manganese sulphate, antibiotics, coccidiostat, vitamins A and D_3, and K	18·0	2·5	6·0	1·0 0·25	3·0 1·0	2·5 1·0	do.	do.

Stock Food	App. No.	Brand	By whom Registered	Materials from which Made	Registered Analysis											
					Sodium Chloride ($NaCl$)	Phosphoric Acid (P_2O_5)	Lime (CaO)	Magnesia (MgO)	Iron (Fe)	Sulphur (S)	Iodine (I)	Copper (Cu)	Cobalt (Co)	Manganese (Mn)	Potassium (K)	Zinc (Zn)	Other
					(Max.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	(Min.) %	%
C.—Stock Licks 5.—*Mixed Stock Licks* Stock Mineral Block	325	Watkins	Watkins Products Inc.	Diacicic phosphate, micronised rock phosphate, calcium carbonate, ferric oxide, magnesium sulphate, ferrous sulphate, ground sulphur, molasses, salt	42·5	8·66	17·9	·39	·616	....	Trace	Trace	Trace	Trace		Trace	

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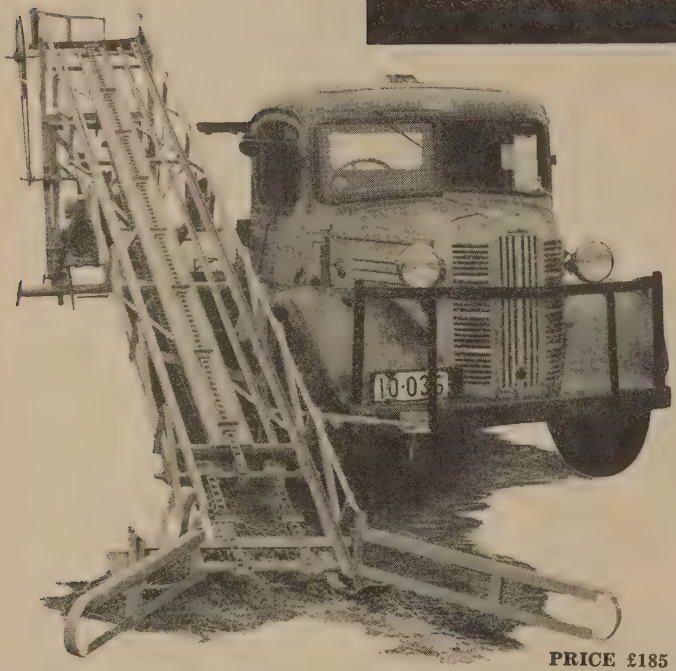

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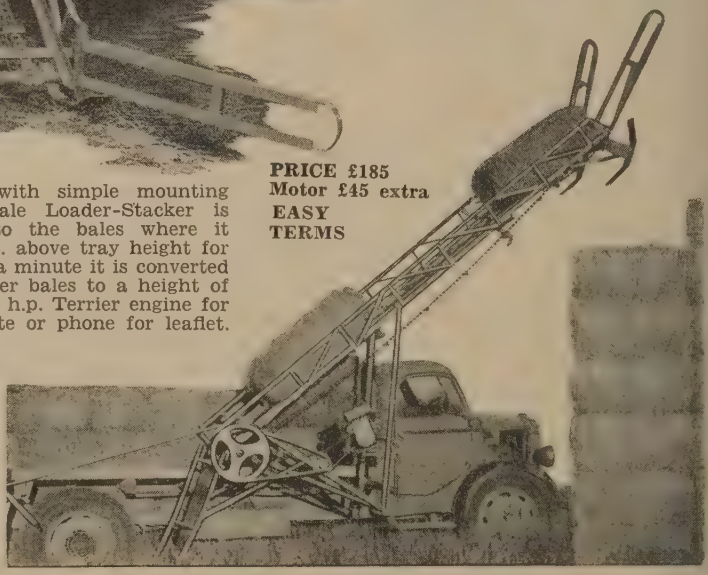

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1.—A dam in the Manjimup area

TOBACCO PRODUCTION IN WESTERN AUSTRALIA

By A. E. BAKER, B.Sc. (Agric.), Tobacco Adviser

THE annual consumption of manufactured tobacco in Australia is in the vicinity of 55,000,000 pounds. Although the public is well acquainted with the use of tobacco for smoking, many people are unaware of the care and attention required to grow such a crop. The following article attempts to outline the conditions and methods as applied to tobacco production in Western Australia.

Although the tobacco plant had its origin in tropical and semi-tropical lands, it is now cultivated under widely varying climatic conditions in many countries of the world. However the quality of leaf produced is dependent upon both climate and soil type.

The Virginian or flue cured type of tobacco grown in Australia requires a light sandy loam soil which must be adequately drained. Generally these soils are low in organic matter as high nitrogen conditions which are associated with high organic matter will produce rank leaf of poor smoking quality.

Sufficient soil moisture should be available to keep the crop growing during the early stages. As the crop grows and the supply of soil moisture decreases, then irrigation is carried out with overhead sprinklers.

In the past, much of our tobacco was grown on low-lying summer moist land without the aid of irrigation. These areas frequently suffered from lack of moisture in the late stages of crop growth during a dry season and they also contained damaging amounts of chloride (salt or sodium chloride). Excessive quantities of chloride in tobacco will result in an un-

desirable low quality type of leaf which is unacceptable to manufacturers. With the advent of irrigation, tobacco has moved away from these low lying "swampy" areas on to higher ground where drainage is better, and where salt has not accumulated in the soil. This higher ground also permits earlier planting thus enabling the crop to grow and reach maturity during the most favourable part of the season.

Tobacco has been grown in many parts of the South-West since the early 1920's but many sites proved unsatisfactory for various reasons such as unsuitable soil, lack of moisture or irrigation and excess chloride. Over the years the Manjimup district has been the most successful growing area. Suitable soils are to be found in the district surrounding Manjimup and extending to the south towards Pemberton and on selected areas in the Northcliffe district, all areas where there is an assured annual rainfall of some 40 to 50 inches together with the general suitability of the country for earth dams for water catchment.

The widespread practice of sprinkler irrigation for tobacco growing which has taken place in recent years has been encouraged by the availability of portable aluminium piping.

Depending upon the season and the moisture content of the soil, tobacco crops may receive from one and a half inches up to eight inches of irrigation water per acre during the growing period.

For the convenience of discussion the tobacco season may be taken through the following stages:—

(1) Seedbeds.
(2) Transplanting.
(3) Field Care.
(4) Harvesting and Curing.
(5) Grading and Marketing.

SEEDBEDS.

An ounce of tobacco seed contains approximately 300,000 seeds which are similar in appearance to poppy seeds. Because of the small size of the seed and the fact that they are sown during the cold winter period, it is essential that the seedbeds are well prepared. Generally one ounce of seed is sown for each five acres of crop to be planted. The seed is mixed with sand or sifted ashes so that it can be spread evenly over the surface of the bed. After sowing, the seed is covered with a thin layer of coarse sand which acts as a surface mulch and prevents the seed from washing out when rain or watering occurs.

2.—Seedlings in a seedbed with the canvas cover rolled back on the right hand side. Note the benzol tins at each end and the right hand side

The sowing of seedbeds takes place during the period from the middle to the end of July and at this time of the year the seed takes about three weeks to germinate. It is essential that the surface of the seedbed soil should be kept moist during this germination period.

Blue mould disease is a constant threat to tobacco seedlings but this can be effectively controlled by the use of benzol.

Canvas or calico covers are used in the seedbeds at night so as to confine the benzol vapour and to protect the seedlings from frost or heavy rain.

3.—Transplanting seedlings

TRANSPLANTING

When the seedlings reach a height of from four to six inches, they are ready for transplanting. The ground which was previously ploughed in the early spring would since have had several cultivations in order to kill weeds and to make a fine surface tilth. Furrows 6 to 8 inches deep are opened at distances of from 3½ to 4 feet apart and fertiliser applied in a band at the bottom of the furrows. After the furrows have been covered in, the seedlings are planted at intervals varying from 21 to 26 inches in the rows.

4.—A field of young tobacco plants

5.—A crop in flower

Depending upon the spacing, there are approximately 6,000 plants per acre.

FERTILISERS

Three tobacco fertilisers are available with the following compositions.

	Nitrogen.	Phosphate.	Potash.
	%	%	%
Low potash tobacco fertiliser	3.3	15.75	5.7
Medium potash tobacco fertiliser	3.5	13.75	10.0
High potash tobacco fertiliser	3.0	11.25	15.0

The rate of fertiliser used varies from 5 cwt. to 11 cwt. per acre depending upon the state of the soil. New land which is deficient in phosphate may need pretreatment with superphosphate at the rate of ½ ton per acre to be followed at planting time with upwards of 10 cwt. of low potash tobacco fertiliser per acre.

Where the soil is reasonably fertile it is common practice to use about 7 cwt. of medium potash tobacco fertiliser per acre. In cases where high soil nitrogen is encountered it is recommended that some 5 to 6 cwts. of high potash tobacco fertiliser per acre is used.

Most Western Australian tobacco requires a higher potash content than is common at present so growers, especially those planting on high nitrogen ground, are encouraged to topdress their land with at least half a ton of sulphate of potash per acre prior to planting.

FIELD CARE

During the early stages of the crop's growth in the field, cultivations are carried out to suppress the growth of weeds and to aerate the soil. Various species of caterpillars must also be controlled by regular spraying with insecticides. After the initial period of four to five weeks following planting out, the crop makes rapid growth. Suckers which develop on the plants must be removed before they become large enough to cause damage. Topping or removal of the flower heads is sometimes practised so that the essential plant nutrients do not become diverted from the leaves.

The application of irrigation water depends upon the seasonal incidence of rain and the soil moisture conditions. In some localities only one watering may be applied to the crop in January. Other areas may receive two or up to six or seven waterings as needed.

HARVESTING AND CURING

At flowering time when the plants are mature, the crop is ready for commencement of harvest. Leaves of the plant ripen progressively from the bottom upwards and some experience is required to know when leaves are ripe for picking. The signs which indicate a ripe leaf depend upon the variety but usually one which has changed from a shiny dark green to a dull yellowish-green with a white midrib is ready for harvesting. Generally two to four leaves at a time ripen on a plant and harvesting of the leaves takes place at approximately weekly intervals.

From six to ten men are required on harvesting days to pick, string-on and load a 16 ft. x 16 ft. kiln of tobacco. One pick from an area of about 4 acres is regarded as sufficient to fill one kiln. The pickers, who walk along the rows, break off the ripe leaves and place them in the crooks of their arms. The leaves are placed on bags which are located at appropriate intervals throughout the rows. When there is a full load on the bags, they are rolled up and transported to the stringing-on shed.

Before the leaf is put into the kiln it must be strung onto sticks. These sticks which are 4 ft. long may have the leaves attached directly with twine or the sticks may be equipped with pointed wires upon which the butts of the leaves are transfixed.

There are usually 5 levels of tier poles in a 16 ft. x 16 ft. kiln and the sticks containing the strung-on leaves are suspended from each of these tiers.

CURING

Tobacco curing kilns are heated either by wood or oil fuel. Although oil fired kilns are more costly to operate than wood, the oil burners are more nearly automatic in action and need not be attended during the nights.

Curing of the leaf commences as soon as the kiln is filled. The process is divided into four stages, namely, colouring, fixing of the colour, drying the web and drying the midrib.

6.—Harvesting tobacco leaves

7.—A set of kilns

Colouring.

The object of this process is to change the green colour of the leaves to yellow. The humidity in the kiln is kept high with a temperature of 80-90° F. and these conditions activate enzymes thus starting a reaction which gradually turns the leaf to a desired lemon colour over a period of from 24 to 36 hours. The high humidity of up to 85 per cent. is obtained by the presence of moisture from the freshly picked leaf together with lack of ventilation in the kiln.

Fixing of the Colour.

This next stage commences when approximately two thirds of the leaf has turned yellow. The temperature is gradually raised to 105° F. and the humidity is lowered by giving the kiln more ventilation. The fixation of colour is completed by further raising the temperature to 125° F. If too much humidity remains in the kiln during the latter part of this phase, the leaf will "sponge" and the desired lemon colour will be lost.

Drying the Web and Midrib.

After fixing, the temperature is raised to 140° F. and the amount of ventilation is increased to dry the web of the leaf. The final stage of the process is the drying out of the midrib by raising the temperature to 170° F. The whole process of curing takes approximately five days but this period may vary as leaf from different parts of the plant will not all take the same time to cure. Different varieties and different localities all account for variations in curing times and curing methods.

When curing is complete, the leaf is removed from the sticks and bulked down in stacks. Care must be exercised in having the leaf at the right moisture content when bulking down. If the leaf is too dry then it will be too brittle to handle and will suffer damage in stacking. On the other hand if the leaf is too moist then much of the desirable colour will be lost in the bulk and there is also the danger of mould development.

GRADING AND MARKETING

The grading of the crop commences in about April or May which is the start of the wet winter period. To prevent the leaf from taking up too much moisture from the damp atmosphere during grading,

wood burning stoves are frequently kept burning in the grading sheds.

There are five major leaf grades which are based on the actual position of the leaf on the plant. Each of these main groups is designated by a letter symbol as follows:—

LUGS (X)—are leaves from the bottom of the plant. They are rounder and shorter than other leaves on the plant, have a dull finish and are inclined to be dry natured.

CUTTERS (C)—are the leaves next above the lugs. They are thin to medium in body and usually the largest and widest leaves on the plant. The texture is fine, elastic and crepe-like in appearance.

LEAF (L)—is medium to heavy in body, is narrow and coarser in texture than the cutter.

SUB-LEAF (F)—may occur within the cutter or leaf grades. This type of leaf is thin and papery, lacks the full development and finish of a cutter or the body and development of ordinary leaf. The presence of sub-leaf in a crop mainly arises from some upset in the nutrition and development of the plant such as nematodes or blue mould.

TIPS (T)—are the smaller leaves from the top of the plant. They are narrow, heavy bodied and coarser in texture than leaf grades.

Each of the above major grades will be further subdivided into anything from three to seven grades according to colour, texture, degree of damage and size. The high grades are bright in colour with a silky texture, a high degree of elasticity, wide and undamaged. As the grades become lower then the colour darkens and is described as mahogany. The texture becomes coarse, less elastic and damage is more pronounced.

Leaf which contains a proportion of green colour due to having been harvested too green or through faulty colouring during curing, is graded separately.

After the leaves are graded they are tied into "hands" each containing from 20 to 40 leaves. These hands of leaf are put into

8.—Well developed plants being examined at a field day

bales under pressure. The weight of a bale may vary from 100 to 200 pounds. The whole of the grading process takes from three to four months to complete and depends upon the size of the crop and the number of people employed on grading. An experienced operator can grade as much as 100 pounds of leaf in a day if the crop is of good quality.

When the bales of leaf are ready they are forwarded to the sale floor where they are appraised and sold under the auction system. After the sales, the leaf is dispatched to the various manufacturers where it is redried to a uniform moisture content of approximately 12 per cent. and stored in cases for a maturation periods of one to two years.

From the above outline it will be realised that a considerable amount of care and attention is required in the production of tobacco leaf. Although a degree of mechanisation has occurred in the tobacco growing industry, there are still a considerable number of individual handling operations which demand a high labour input. However, tobacco is a high return crop and there are a number of growers who are able to obtain a gross return of £700 or more per acre.

Modern itinerant beekeeping demands that beekeepers be away from home most of the season. Some beekeepers have overcome this by taking their homes with them and the above shows the outfit of Mr. S. Taylor, of Moora, in the karri forest near Quinninup Mill.

The living van is fully fitted out with bath, kitchen and bedroom and Mrs. Taylor is enjoying a good look at Western Australia until her two children reach school-going age. The other van shown is the extracting van with which Mr. Taylor removes the honey from the hives.

INSECT PESTS

FRUIT FLY CONTROL WITH ROGOR 40 AND LEBAYCID

(A PROGRESS REPORT)

By D. SHEDLEY, B.Sc. (Agric.), Entomologist

THE Mediterranean fruit fly has been present in Western Australia for over 60 years and during that time many types of insecticides have been tested against the pest. Traps and lures were amongst the earliest control measures adopted, but these gave way to sugar solutions poisoned with such materials as arsenic and sodium fluosilicate.

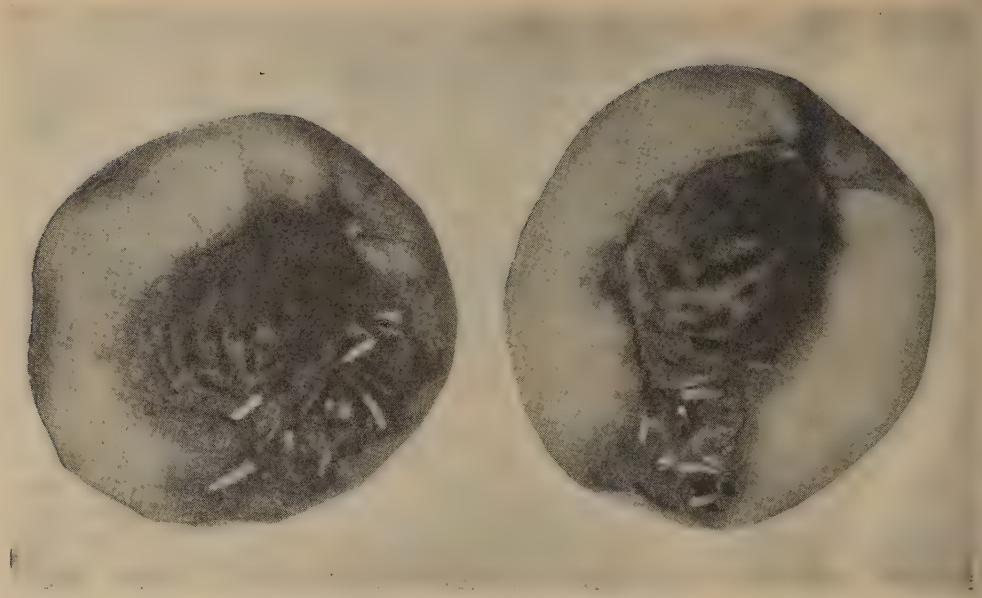
More recently it has been shown that certain protein substances as well as sugar play an important part in the diet of fruit flies and that hydrolysed protein and Malathion make a very effective bait.

The recently developed Malathion yeast preparations are an important step forward in fruit fly control but of equal importance is the development of several chemicals which render the flesh of treated fruits toxic to both fruit fly eggs and young maggots.

The first of these materials to be tested was Dipterex and this has already been included in Departmental recommendations. The two latest preparations tested are Rogor 40 and Lebaycid.

These two newly developed organophosphorus compounds act in much the same manner as Dipterex. They are effective in killing the larvae and preventing egg development in fruit. However unlike Dipterex they are able to kill the immature stages in citrus. This, coupled with good residual properties and toxicity to adult flies make them very valuable weapons against fruit flies.

Adult female of Mediterranean fruit fly (greatly enlarged)



Peaches showing typical fruit fly damage

As neither Rogor 40 nor Lebaycid has been available for an entire season it has not been possible to finalise recommendations, nor to test one material against the other. This however, will be remedied as soon as possible during the coming season.

Preliminary tests were undertaken in the laboratory by dipping infested fruit into a range of dilute solutions. Loquats, mandarins and cumquats were used in the tests with Lebaycid but only loquats were available for the Rogor 40 dips.

Field trials using Lebaycid as a cover spray were made on a number of early apricots and peaches and cumquats were treated throughout the season. Where normal quantities of insecticide were applied excellent results were achieved.

Rogor 40 was used to spray three varieties of late canning peaches, some blocks of Bartlett and Keiffer pears and several individual trees of other pear varieties. A range of citrus including mandarins, navel oranges and grapefruit were also treated.

Results were assessed by examining most or all of the crop, sorting for struck and clean fruit and holding the struck fruit for records of fly development. Practically the entire crop from sprayed trees was suitable for marketing despite the fact that in most years almost all the fruit was ruined by fruit fly attack.

For those growers wishing to try Rogor 40 or Lebaycid it is suggested that they use the concentrations recommended by the manufacturers. Effectiveness can be expected to last for at least two weeks and probably three; a single spray at the first sign of strikes should be sufficient for early stone fruit but two sprays may be necessary for other fruit.

As in the case of most insecticides certain routine precautions are necessary when handling fruit fly sprays. The instructions printed on the labels should be read carefully and followed in detail. This applies particularly to the use of Lebaycid in the vicinity of poultry or other birds.

PLANT DISEASES

SCLEROTINIA ROT OF BEANS

By S. C. CHAMBERS, M.Sc., Plant Pathologist, and
M. HARDIE, Vegetable Instructor

INVESTIGATIONS over the past three years suggest trenching is the most important practice for controlling Sclerotinia rot in market gardens. None of the remaining measures under test gave satisfactory control of the disease, although some reduced its incidence significantly.

Late crops of beans have been a feature of Spearwood market gardens for many years. Sowings are made early in March for harvesting in the May-June period, when prices normally assure a good return.

However, over the past decade, Sclerotinia rot has been steadily increasing in market gardens and has been the cause of heavy losses. If the present trend continues, many growers may be forced to abandon this planting and modify their rotations accordingly.

CAUSE AND SYMPTOMS

The fungus *Sclerotinia sclerotiorum* (Lib.) de By is the causal organism of the disease, which is most destructive in the post flowering phase of these autumn plantings.

Infection may occur at any point on the leaves, stems and pods. A soft, watery rot develops rapidly, and the affected tissue becomes covered with a white mycelial growth (Fig. 1). As the decay continues black pebble-like sclerotia are formed in this white growth.

When the fungus invades portion of a stem, the vine beyond the point of entry quickly wilts and dies (Fig. 2). This is most serious when the basal portion of the stem is attacked, because death of the whole vine is an automatic consequence. Where soil is heavily infested by Sclerotinia, any runners, leaves or pods partially covered as a result of inter-row cultivation, soon develop symptoms of the disease.

CARRY OVER AND SPREAD

The disease is carried over in the soil by means of sclerotia which germinate during cool, moist conditions and give rise to small, funnel shaped apothecia (Fig. 3). These are very prevalent in the early part of May when weather conditions are usually most favourable for their development. The apothecia, after emerging from the soil, discharge masses of spores which are carried about by wind and spread the disease throughout the crop.

Alternate hosts also play an important part in the perpetuation of this malady. In W.A. it has been recorded on Brussels sprouts, cabbage, cauliflower, celery, lettuce, potato, red beet and tomato as well as on certain weeds, ornamentals and pasture plants.

EXPERIMENTAL WORK ON CONTROL ASPECTS

A series of experiments for evaluating several control measures, has been conducted in the market garden of Mr. L. Goodchild, Spearwood. This site proved to be ideal as severe outbreaks of the disease occurred in each of the three test seasons.

Experiment 1: Cover Spraying.—In 1958, portion of a Westralia bean crop was used for determining the relative efficacy of five fungicidal preparations as cover sprays (Table 1). Their selection was based on results obtained by Miss R. Henderson, honours student at the University of Western Australia.*

The experimental design was a simple randomised block containing 6 replications of 6 treatments and the component plots measured 18 links in length by 3 rows in width. Spraying was commenced on March 13, 1958, and continued at 10-14 day intervals until May 28, 1958.

The disease incidence in relation to treatment was assessed periodically, being based on the percentage of plants with basal stem rot in the centre row of each plot. An analysis of the assessment made on May 28, is contained in Table 1.

TABLE 1

Effect of various cover sprays on incidence of Sclerotinia rot

Fungicide	Concentration	Percentage of Plants with Basal Stem Rot	Data transformed (Arc sin)
			% diseased
Bordeaux*	4 : 4 : 40	39	38·3
Phygon	1½ lb./100 gal.	45	42·1
Captan	2 lb./100 gal.	61	51·4
Ferbam	2 lb./100 gal.	67	55·9
Ziram	1¼ lb./100 gal.	72	58·2
Control	....	63	52·6
Differences for significance ...		P = 0·05	8·7
		P = 0·01	11·7

* Caused injury to plants.

Experiment 2: Dusting with P.C.N.B.—Another part of the same crop was selected for a pilot trial with the fungicide, Pentachloro-nitro-benzine (P.C.N.B.). This was applied as a dust to the soil immediately before sowing and also to the plants, grown on this ground, at flowering time in early May.

The treated area consisted of 2 plots, each 360 links in length by 3 rows in width, and P.C.N.B. was applied at the rate of 60 lb. of active ingredient per acre on each occasion.

Fig. 1.—Bean pod covered with white mycelial growth of *S. sclerotiorum*

An assessment of disease incidence was made on June 4, 1958, being based on the percentage of plants with basal stem rot in the centre row of each plot. The incidence of disease in the treated and control plots was calculated as 22 per cent. and 48 per cent. respectively.

* This work was carried out under the supervision of Mr. W. P. Cass Smith, Government Plant Pathologist, W.A. Department of Agriculture, when Miss Henderson investigated "Sclerotiniose" in part fulfilment of the requirements of an Honours degree.

Experiment 3: Dusting, Spraying and Weeding.—In view of the previous year's results, portion of the 1959 Westralia bean crop was used for evaluating the following possible control measures:—

(1) Two dustings with P.C.N.B. at the rate of 60 lb./acre; the first applied to the soil the day before sowing and the second to the growing crop in early May.

(2) Cover spraying with Phygon at the rate of 1½ lb./100 gal. at intervals of 10-11 days.

(3) Weeding and inter-row cultivation at intervals of 10-11 days.

Fig. 2.—A vine attacked at ground level

The trial was of factorial design, containing four replications of 8 treatments combinations, and each individual plot measured 21 links by 3 rows.

Spraying was commenced on March 10, 1959, and continued until May 25, 1959. Weeding and inter row cultivation were carried out over the same period.

An assessment of disease incidence in relation to treatment was made on June 4, 1959 (Table 2). This was based on the number of plants with diseased stem bases in randomised samples of 40 plants from each plot.

TABLE 2

Effects of various practices on incidence of S. sclerotiorum

Treatment	Percentage of Plants with Basal Stem Rot	Data transformed Arc sin
		% diseased
Weeding, PCNB, Phygon	14	21·6
Weeding, Phygon	16	22·8
Weeding	20	26·5
Weeding, PCNB	23	28·0
PCNB, Phygon	28	31·9
PCNB	29	32·8
Phygon	34	35·5
Control	36	36·7
Differences for significance	P = 0·05	8·6
	P = 0·01	11·7

Experiment 4: Deep Trenching.—During January, 1959, portion of the area which had borne the diseased bean crop of the previous autumn, was trenched to a depth of 18 inches. The trenched area measured 352 links by 100 links.

On March 10, a Westralia bean crop was sown on this ground and also on the remaining comparable untrenched ground. Both areas were divided into plots measuring 21 links by 3 rows and, on June 4, the disease was assessed in 32 plots selected at random from each treatment (Table 3). The method of assessment was the same as described in Experiment 3.

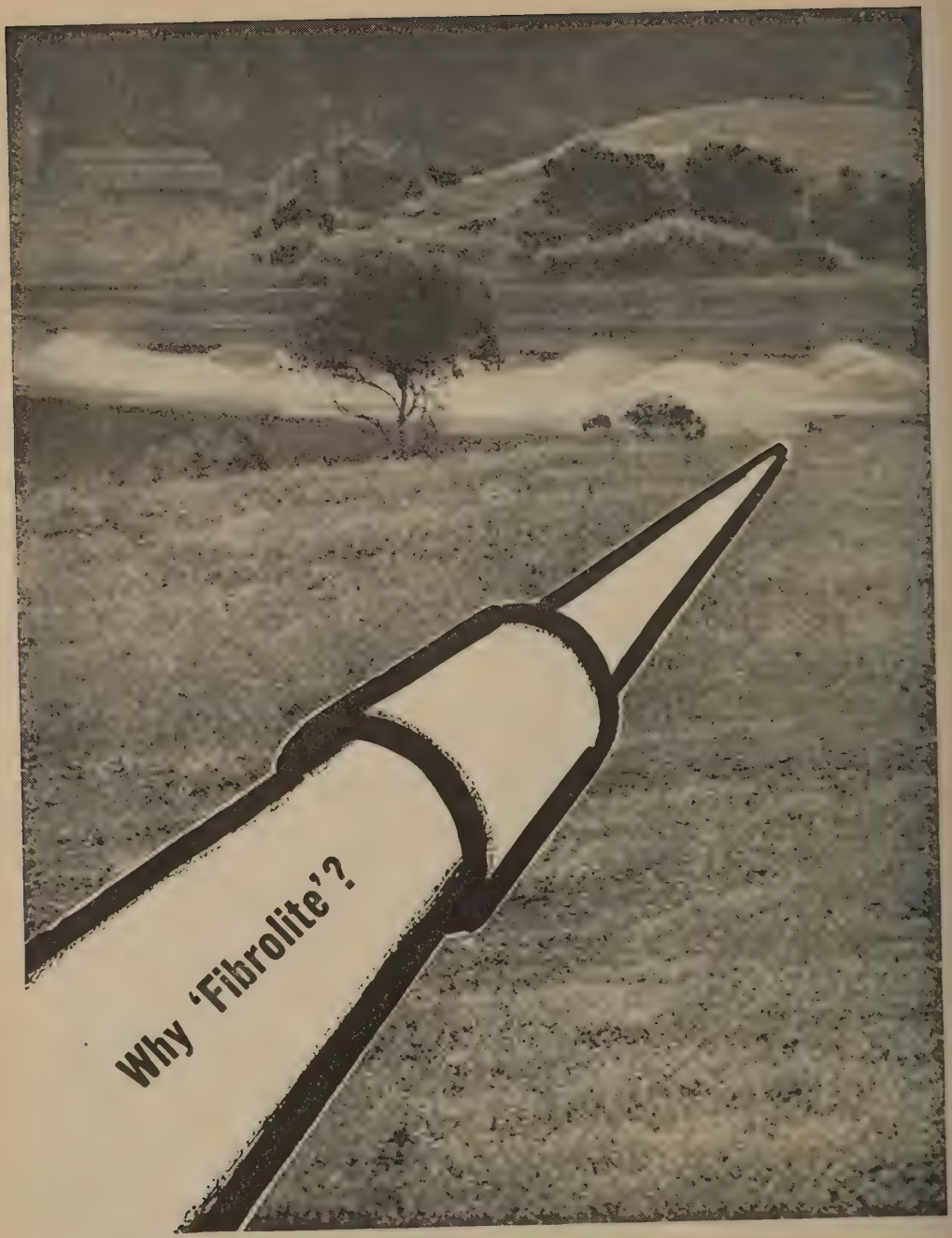
TABLE 3

Effect of deep trenching on the incidence of S. sclerotiorum

Type of Ground	Percentage of Plants with Basal Stem Rot	Data transformed Arc sin
		% diseased
Trenched	2	5·35
Untrenched	25	29·37
Difference for significance	P = 0·001	5·37

Experiment 5: Deep Trenching and Dusting.—Because of the previous two seasons results, the 1960 trial was designed to further test the following measures:—

(1) Trenching of soil to a depth of 18 inches.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(2) Two dustings with P.C.N.B. at the rate of 30 lb./acre. the first applied at the commencement of flowering and the second applied 14 days later.

The practice of hand weeding was not evaluated again, as the trenched ground had remained almost completely weed free during the 1959 season.

The trial was of factorial design, containing 32 replications of the four treatment combinations. In practice, the design was obtained by first dividing the experimental area into two narrow strips, each measuring 352 links by 33 links. One strip was trenched and later the whole area was subdivided into plots, each each measuring 22 links by 1 row.

Trenching was carried out during February and the plots were sown to Westralia beans on March 4. The first application of P.C.N.B. was made on April 21, when the apothecia began to emerge in great numbers. On May 21, the incidence of disease was assessed in relation to treatment (Table 4). This was based on the number of plants with diseased stem bases in randomised samples of 15 plants from each plot.

TABLE 4

Effect of P.C.N.B. and deep trenching on the incidence of S. sclerotiorum

Treatment	Percentage of Plants with Basal Stem Rot	Data Transformed Arc sin
		% diseased
Trenching, dusting	12·19	20·43
Trenching	15·79	23·41
Dusting	19·82	26·43
Control	30·65	33·02
Difference for significance	P = 0·05	3·63
	P = 0·01	4·80

DISCUSSION

The increase in the incidence of Sclerotinia rot during recent years seems to have followed a general change in cultural methods, since World War II. Trenching is no longer practised, and ploughing has been largely superseded by the use of rotary hoe implements, which leave diseased plant residues in the surface soil.

The results of experiments 4 and 5 demonstrate the value of trenching and suggest the current prevalence may be associated with its discontinuance. Furthermore, the greater measure of control obtained by trenching a wider strip (Experiment 4), emphasises the necessity of trenching all of an infested area at the one time.

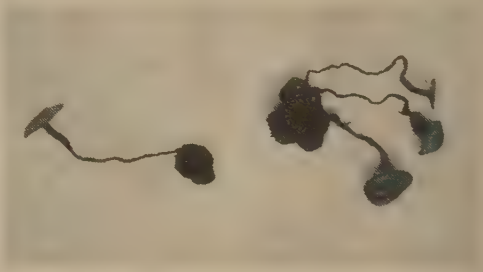

Fig. 3.—Small funnel-shaped apothecia arising from sclerotia of *S. sclerotiorum*

Brooks (1940) reported that sclerotia, buried deeper than 3 inches, did not form apothecia. Consequently as rotary hoes distribute sclerotia throughout the surface soil trenching should be at least three inches deeper than the depth worked by these machines.

One of the main objections by growers to the pre-war hand method of trenching is its prohibitive cost. As its main purpose is to prevent apothecial development by deep burial of the sclerotia, any alternative means of achieving this, would be of equal value.

A modified method of trenching is being employed by some gardeners who claim it can be carried out for approximately £60- per acre. This method involves first opening a 17 in furrow. The top 12 inches of one wall is then ploughed in and covered with 5 inches of soil from the bottom of the new furrow. The covering is dug by hand and represents a depth of one spade.

It is not known how frequently land should be trenched in metropolitan gardens as the longevity of sclerotia has not been determined under local conditions. Overseas reports suggest viability of sclerotia is affected by environmental factors. For example, Stoner and Moore (1953) reported the complete destruction of sclerotia after being buried for 20 days in a field flooded for rice culture. However, Hungerford and Pitts (1953) found that sclerotia were still viable after being stored under dry laboratory conditions for 7 years. Therefore, further field work is contemplated in local market gardens

to detemine the longevity of sclerotia in trenched soil.

None of the remaining measures gave satisfactory control of the disease although some reduced its incidence significantly. Hand weeding appeared to be of value but was only necessary on untrenched ground.

In the case of P.C.N.B., the time of its first application to the flowering crop, seemed to be of considerable importance. for instance, in experiments 2 and 5, some control was obtained by using it just as the apothecia began to emerge in great numbers. However, it had little effect upon disease incidence when the first application was made approximately one week after this stage (Experiment 3).

Of the spray materials evaluated, none gave sufficient control to warrant its recommendation.

ACKNOWLEDGMENTS

The authors are indebted to Mr. L. Goodchild, Coogee, on whose property the trial was conducted. Acknowledgment is also made to Mr. W. Pickering for his assistance with the field work and to Mr. M. Thornett for analyses of experimental results.

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LEAF SCORCHING

By PLANT PATHOLOGY BRANCH

DURING the summer months, leaves of many plants develop browning and scorching which progresses inwards from the leaf margin or downwards from the leaf tip. The affected parts become dry and brittle and may break away from the remaining green areas. Ornamental trees, shrubs and other plants, certain orchard trees and in fact a large number of species may be affected. Two plants which are very susceptible to this type of injury and are rarely seen without it are the loquat tree and the butterfly tree (Bauhinia).

CAUSES

The causes of leaf scorch are many and varied but generally it results from the failure of sufficient water and nutrients to reach the leaves concerned. This may seem to suggest that the plants have been underwatered. Often that is true but not always, because it sometimes happens that with abundant water supplies, scorching may occur and it is then that one or more of the following factors may have been responsible.

(1) Dry hot weather. This is common in summer in Western Australia and evaporation from leaves is often so rapid that the roots cannot replace the moisture loss quickly enough.

(2) Exposed windy situations. Constant exposure to drying winds causes excessive moisture loss from plants.

(3) Fertiliser "burn." This is due to excessive amounts of fertiliser, especially if placed too close to the plant.

(4) Salt. Salty soils aggravate leaf scorching as also does the use of water with a high salt content.

(5) Inadequate nutrition. "Complete" fertiliser mixtures, e.g., containing sulphate of ammonia, superphosphate and potash are better than those containing only one of these components. Potash deficiency, for example often causes leaf scorch.

(6) Root injury due to implements.

(7) Poor root system. This may result from waterlogging.

(8) Root parasites.

Fig. 1—Apple leaves showing marginal leaf scorch

CONTROL

(1) Liberal supplies of water are necessary in hot, dry weather.

(2) Situations sheltered from prevailing winds are preferred. Otherwise wind breaks should be provided.

(3) Artificial fertilisers should not be applied in excessive amounts or placed too close to the base of plants.

(4) Avoid soils or water with too high a salt content.

(5) Provide adequate nutrition by using "complete" fertilisers. Liberal supplies of potash in the mixture are often an advantage.

(6) Avoid unnecessary root injury with cultivating implements.

(7) Provide adequate drainage to prevent waterlogging.

(8) If fungi, eelworms or other root parasites are suspected, a special examination may have to be made before appropriate steps can be taken to correct the condition.

Fig. 2—Rose leaves showing marginal leaf scorch

"GERANIUM RUST"

By PLANT PATHOLOGY BRANCH

GERANIUMS are affected by relatively few troublesome diseases. However, in Western Australia, leaf rust of these plants is very common and can become a serious problem, particularly in the more susceptible varieties growing in sheltered positions.

SYMPTOMS AND SPREAD

Rust in Geraniums is caused by the fungus *Puccinia pelargonii-zonalis*. It is readily recognised by the raised reddish brown pustules which occur on the lower surface of the leaf. As these blister-like pustules develop they assume a zonate appearance and change to a dark brown colour (Fig. 1). Affected leaves gradually yellow, except for the areas immediately above the pustules which remain green, so that when seen from above the leaves appear green spotted (Fig. 2). Diseased leaves soon fall from the plant giving it a very straggly appearance.

Numerous spores or fungal seeds are produced in the pustules. These are blown by the wind from diseased to healthy leaves and to adjacent healthy plants where they germinate under moist conditions and give rise to new infections.

Geranium rust is most common in summer—development and spread being favoured by hot humid weather. However, it can be present in the garden throughout the whole year, particularly if plants are grown in a sheltered position and the weather conditions are right for development.

CONTROL

1. Wherever possible, choose an open sunny situation for growing Geraniums as, under these conditions, humidity is reduced and therefore the disease is less likely to become serious.

Fig. 1—Geranium leaf infected with the rust fungus viewed from the lower surface. Note the rust pustules which are reddish brown to dark brown in colour and appear concentrically zonate

Fig. 2—Older leaf viewed from above showing leaf yellowing except in the region of the pustules where the green colour is retained. Healthy leaf for comparison

2. Prune the plants back severely in late winter to promote healthy growth, and burn the prunings.

3. Protect the new growth from infection by spraying periodically and thoroughly with either colloidal sulphur or Zineb at the rate of 1 ounce in 3 gallons of water, being sure to spray the undersides of the leaves as well as the top and to get good penetration into the centre of the bush.

4. If some varieties prove less susceptible than others to the disease, they may be selected for propagation by cuttings.

WESTRALIA BEAN SEED

Because of the increased acreages sown to the rust-resistant "Westralia" bean in the Carnarvon area, and the necessity for second sowings following cyclone damage, stocks of seed were practically exhausted this year.

When discussing the problem of seed supplies for subsequent sowings, the Minister for Agriculture (Mr. C. D. Nalder) said that it was unlikely that there would be any shortage.

The main grower of "Westralia" seed, Mr. B. Arbuckle of Balcatta, would arrange to increase his sowings to cover any reasonable quantities of seed likely to be required. While supplies of pedigree seed could be built up in the Carnarvon district there were definite advantages in producing the seed in the metropolitan area where it could be closely supervised for certification by officers of the Department of Agriculture.

Bulk Handling of Superphosphate

Some Recent Experiences

by H. G. CARISS, B.Sc. (Agric.)

A MAJOR factor in our agricultural production is the outlay for fertilisers, including the cost of their application to the land. Any means which can be employed to reduce these costs are therefore of extreme importance to the State's agriculture. The bulk-handling of fertilisers could be one way of reducing these costs to the farmer.

The transport of superphosphate in bulk is not new, as an investigation into its possibilities was carried out in 1951 by the Department of Agriculture in association with Co-operative Bulk Handling Ltd.

This was initiated because of a steep rise in bag costs which rose from 39s. 2d. to 69s. 6d. per dozen or nearly £3 10s. per ton of fertiliser.

Two successful demonstrations were held at Cunderdin. Grain-handling machinery specially adapted for the purpose was used and the results indicated that, with modifications, little difficulty would be ex-

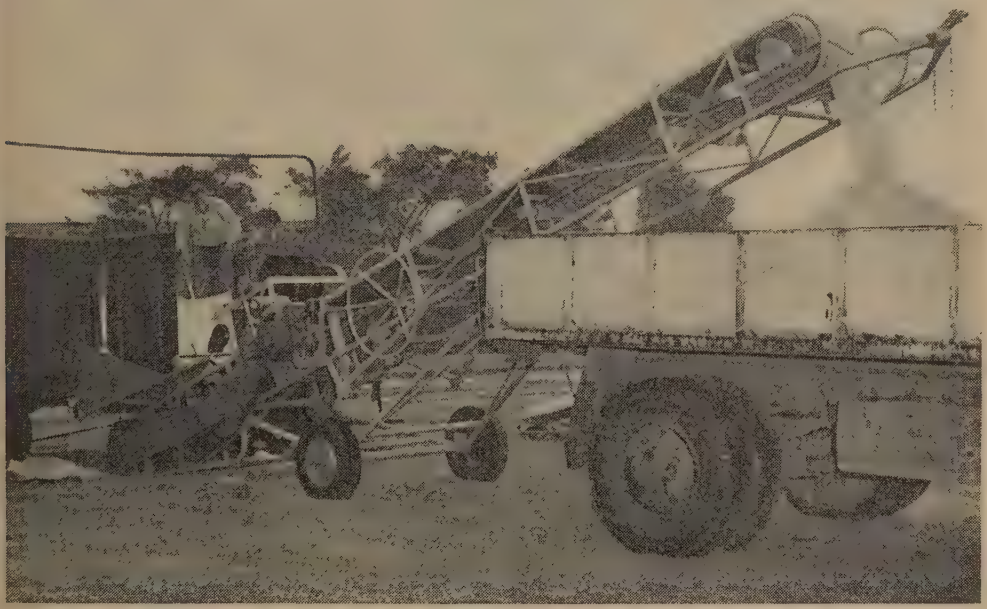

Fig. 1.—Prototype bulk fertiliser unloader used in 1958 demonstrations. This machine used an endless rubber belt and "Clark" shovel

perienced with the actual mechanical handling of the superphosphate. A major disability at the time was the lack of handling and storage facilities on the farm. The results were published in the Departmental Journal for December 1951.*

Possibly as a result of a drop in jute prices, the matter received little attention between 1951-1958, and no further planned investigations were carried out. However, during this period one or two farmers did obtain some of their superphosphate supplies in bulk. From their experiences it seemed clear that while considerable savings could result from bulk transport, the carriage of bulk super by rail was not a practical proposition on account of the unavailability of suitable unloading equipment.

In 1958 further consideration was given to bulk-handling, in particular to that portion required for top-dressing which could be applied to the paddocks in the summer-autumn period before cropping was due to commence.

Various authorities representing the Government as well as superphosphate manufacturers and users were associated with demonstrations at a number of country centres late in 1958. The prototype equipment used was loaned by Messrs. Cuming Smith & Mount Lyell Farmers Fertilisers Ltd. who had collaborated in its design.

The machine, which was easily transported behind a car or utility, consisted of a portable belt elevator to which was attached a "Clark" shovel for unloading the rail truck. The machine worked quite satisfactorily, the fertiliser being transferred expeditiously from truck to wagon. One of the motor trucks used was equipped with a bin to which there were special attachments for spreading the fertiliser and emptying the truck. This outfit had already been operating satisfactorily in the Boyup Brook area.

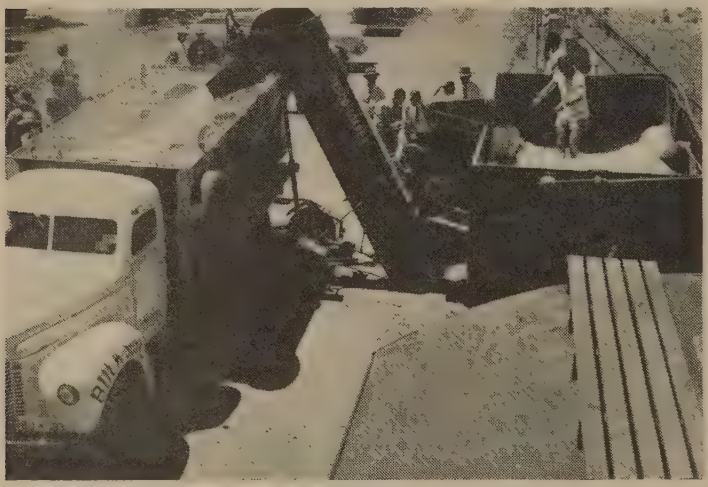

Fig. 2.—Bucket and chain elevator used with 1959 demonstrations. "Clark" shovel also used for emptying rail truck

It is of interest that two of the belt type loaders were in operation during the year. The ease of operation of this machine is quite clearly shown in the illustration (Fig. 1) which shows the unloading of the superphosphate from the rail truck into a bulk motor wagon.

In 1959 a new type of bulk loader, based on the prototype machine used in 1958, was demonstrated at six centres, Kojonup, Dumbleyung, Beverley, Corrigin, Cunderdin and Wongan Hills, during the first part of December.

All the demonstrations were very satisfactory and showed quite clearly that superphosphate could be easily and expeditiously transferred from rail to motor truck. The loader or "unloader," using a

* W.A. Department of Agriculture Journal Vol. XXVIII (Second Series) No. 4 p. 380 D. S. Horwood. "Bulk Handling of Superphosphate."

Fig. 3.—Close-up of top of road truck showing super pouring into the truck. Also chain and scraper gear used for moving fertiliser to screw feed at rear of truck

chain of buckets, was some improvement on the previous type which used an endless belt. Loading was simpler and less space was required which could be important in some situations. This outfit is also easily pulled behind a car or utility.

The operation of the machine is clearly shown in the accompanying illustrations (Figs. 2 and 3) taken at the Beverley and Wongan Hills demonstrations. They indicate the ease with which the fertiliser was handled by the elevator and the attached "Clark" shovel. At the demonstrations 4 tons were transferred in under 20 minutes.

The motor truck used in conjunction with the unloading was the one used in the Boyup Brook area and previously referred to. The illustrations (Figs. 3, 4 and 5) show the attachments to the truck to provide not only for the actual broadcasting of the superphosphate, but the even removal from the bin. The close-up shows the scraper bars attached to chains which drag the material to the rear of the truck where it is directed to the spinner by two spiral feeds. These two attachments are driven off the truck wheel, whereas the spinner itself is driven by a small engine

Fig. 4 — View of bulk truck showing engine driven spreader. Screw feed and scraper bars (see Fig. 3) are operated by chain drive off rear wheels of truck

mounted on the rear of the truck shown in the photographs of the actual topdressing operation.

These demonstrations showed that one of the main problems of bulk-handling, viz., the transfer from rail to motor truck, had been solved and that it was possible for a farmer to have the topdressing of his pastures carried out expeditiously and economically. The costs quoted at the demonstrations for such contract work would be on the basis of 10s. per ton for the first 10 miles and 1s. per ton mile over 10 miles for cartage, plus 2s. per acre up to ¾ bag to the acre and 2s. 3d. over that quantity, for the actual topdressing. These rates are on a par with normal contract prices for bagged deliveries.

The price per ton for superphosphate (ex works—less 5s. per ton for cash) at the time of the 1959 demonstrations was:

£12 13s. per ton in new bags.

£11 13s. per ton in farmers' bags.

£11 4s. 6d. per ton in bulk.

These showed a difference of £1 8s. 6d. in favour of bulk against new bag lots and 8s. 6d. using farmers' own bags. With new bags the value of the bags for refill and other purposes must be considered.

The major advantages in the bulk-handling of superphosphate are:—

(1) It is possible to have fertiliser delivered and **spread** for approximately the same cost as for bagged super delivered. There is a saving roughly equal to the cost of topdressing.

(2) Bulk super is better for long term storage. Bag losses are reduced. Bulk heaps or inexpensive rough timber bins with galvanised iron covers store better than bag heaps, and cost less per ton. Cropping requirements could be obtained early, thus avoiding possible delays at seeding time.

(3) Bulk superphosphate is more suitable for aerial topdressing. Usually relatively large quantities are required at one dump.

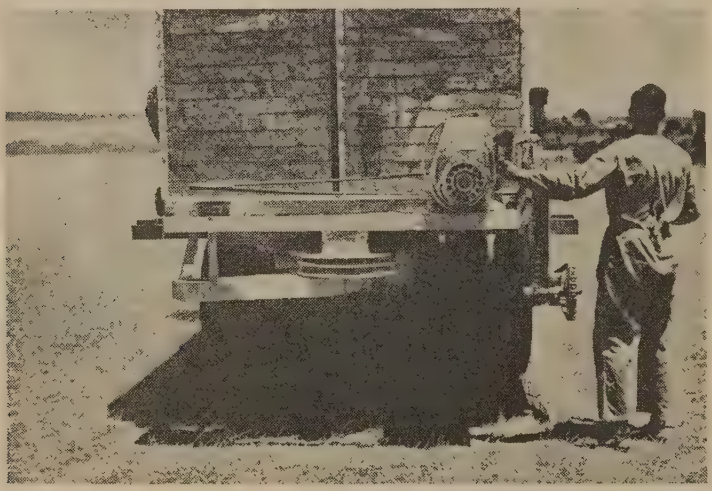

Fig. 5.—Rear view of topdressing truck showing engine driven spinner type spreader

Possibly as a result of increased interest in and usage of bulk superphosphate, these charges have dropped somewhat. Latest quotations are 7s. 6d. to 8s. 6d. per ton for the first mile (includes unloading charge); 1s. per ton mile for the next seven miles and 9d. per ton mile, subsequently. Spreading charges are quoted at 1s. 6d. to 1s. 10d. per acre for rates of 90 to 120 lb. per acre of fertiliser.

The price quoted at the demonstration for the loader was £300. The outfit could be used for the handling of other materials in bulk such as wheat and other grain, lime, sand, gravel, etc.

At the present time the greatest application for bulk-handling appears to be in relation to the topdressing of pasture lands. This work is normally carried out during the early part of the year, before cropping commences. With the availability of suitable handling equipment, and efficient operators doing the work by contract, this important phase of the farm operations could be carried out more efficiently and economically than at present.

It is of interest that this season there has been a marked increase in the demand for the supply of superphosphate in bulk. Up to the beginning of June 1960, over 15,600 tons had been supplied from the several fertiliser works compared with 6,000 tons for the 1959 season.

As farmers become more aware of its advantages, it is believed that the practice will become more popular.

PEDIGREE SEED SUPPLIES

The Minister for Agriculture (Mr. C. D. Nalder), has advised that supplies of pedigree seed of wheat, oats, barley and Wimmera ryegrass will be available for distribution from the forthcoming harvest at the Department's Research Stations. Varieties available this season will be:

WHEAT

(Midseason) — Baroota Wonder (hay variety); Bencubbin; Eureka (rust-resistant); Kondut.

(Early)—Gabo; Wongoondy (rust-resistant); Insignia 49 (rust-resistant).

(Very Early)—Bungulla.

OATS

(Late)—Algerian.
(Midseason)—Avon; Dale.
(Early)—Ballidu; Kent.

BARLEY

Beecher; Prior.

Prices per bag of three bushels inclusive of rail freight to farmer's siding will be:
Wheat, 60s.; Oats, 40s.; Barley, 55s.;
Barley (pickled seed) 58s.

WIMMERA RYEGRASS

"Merredin" Early Strain.

Prompt attention to orders will be ensured if the following directions are observed by intending applicants:

(1) Make early application direct to the Department of Agriculture, St. George's Terrace, Perth.
(2) Give clearly full name, postal address, and siding to which the seed is to be railed.
(3) As soon as possible after receipt of account, remittance should be forwarded. Statements are sent out in order of receipt of the application. No definite reservations can be made until the seed is paid for.

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We suggest that the Journal is worth keeping and that a year's issue will make an attractive and useful volume for your library—a volume that is full of sound factual information, attractively presented.

Arrangements have been made for the compilation of a comprehensive index to be incorporated in the December issue—a feature which will greatly enhance the value of the Journal as a work of reference.

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FACTS . . . AND FIGURES FOR THE MAN ON THE LAND

BY J. A. MALLETT

FARM or station life calls for the exercise of so many different skills that the farmer or pastoralist is usually an accomplished handyman. For those whose schooldays are far behind them however, the most difficult part of many tasks is that of dealing with the calculations involved, and it is hoped that these facts and figures will serve as a handy aid to those whose mathematical ability has not kept pace with their manual and technical skill.

MEASURES OF LENGTH

The basis of most British measurements of length is the Imperial Linear Measure given below:

12 inches = 1 foot.
3 feet = 1 yard.
5½ yards = 1 pole, rod or perch.
40 poles = 1 furlong.
8 furlongs = 1 mile.

There are many other lesser-known units of length, some of which are obsolete or are reserved for special purposes.

The Point (1/72nd of an inch) and the **Line** (1/12 of an inch) are seldom used outside the printing trade.

The Hand (4 in.) is used in measuring the height of a horse at the withers. Like the **Span** (9 in.), and the **Palm** (3 in.) this was originally a rough measurement using the human hand. The **Cubit** (about 18 in.) was another old measurement using the forearm from the elbow to the tip of the middle finger.

The Fathom (6 ft.) is used in soundings for measuring the depth of water, and is also used in measuring ropes and cordage.

The Furlong (220 yds. or 10 chains) is one-eighth of a mile. The name was originally "furrow-long," an Old English term. It is believed to be the approximate distance a span of oxen travelled in ploughing before they were halted for a "breather."

The Mile of 1,760 yds. is the English Statute mile. The name comes from the old Roman unit of length which was 1,000 (mille) double paces. The Nautical or Geographical Mile is one minute of longitude measured along the Equator (6082.66 ft.) or 2027.55 yds. but in British practice it usually refers to the Admiralty Measured Mile of 6,080 ft. or 2026.66 yds. The term **knot** is a unit of speed and refers to nautical miles per hour.

The League (3 miles) is a measure that is seldom used today.

SURVEYOR'S UNITS

In land surveying, the Gunters Chain Measure is used. This measuring chain was introduced by Edmund Gunter, inventor and astronomer who lived from 1581 to 1626. The chain is 22 yds. or 4 poles long and is made up of 100 links each 7.92 in. long.

7.92 inches = 1 link.
100 links = 1 chain.
10 chains = 1 furlong.
80 chains = 1 mile.

MEASURES OF AREA

The Imperial Square Measure given below is standard for most surface and land measurements in British Commonwealth countries:

144 square inches = 1 square foot.
9 square feet = 1 square yard.
30½ square yards = 1 square pole.
40 square poles = 1 rood.
4 roods = 1 acre.
640 acres = 1 square mile.

ALL ABOUT AN ACRE

An acre contains:

6,272,640 square inches.
100,000 square links.
43,560 square feet.
4,840 square yards.
160 square poles.
10 square chains.
4 roods.

and there are 640 acres in a square mile.

Judging an Acre.—An area measuring 70 yds. by 70 yds. is approximately an acre. Such an area contains 4,900 sq. yds. or 60 sq. yds. more than the 4,840 sq. yds. of a measured acre.

Rainfall per Acre.—One inch of rain deposits 6,272,640 cubic inches of rain on an acre of land. This means 3,630 cubic feet or—taking the commonly accepted figure of 6¼ gallons per cubic foot—the inch of rain would deposit 22,687 gallons of water on each acre. A gallon of water weighs 10 lb. and a cubic foot of water (6¼ gals.) weighs 62½ lb. so the inch of rain puts approximately 101 tons of water on each acre.

Implement Travel Per Acre.—Farmers often wish to know how far a certain implement must travel to cover an acre. A simple method is to divide 660 by the width of cut in feet. This gives the number of chains the implement must travel to cover an acre. For example, a 10 ft. implement would have to travel 66 chains; an 8 ft. machine 82½ chains; a 6 ft. machine 110 chains and so on.

MEASURES OF VOLUME AND CAPACITY

SOLID OR CUBIC MEASURE

1,728 cubic inches = 1 cubic foot.
27 cubic feet = 1 cubic yard.

LIQUID MEASURE

4 gills = 1 pint.
2 pints = 1 quart.
4 quarts = 1 gallon.

DRY OR CORN MEASURE

2 gallons = 1 peck.
4 pecks = 1 bushel.
8 bushels = 1 quarter.

The Pint contains 20 fluid ounces. A fluid ounce of water weighs 1 oz. avoirdupois so that a pint of fresh water would weigh 1¼ lb.

The Gallon.—The standard Imperial gallon introduced in 1824, contains 277.27 cubic inches and holds 10 lb. of distilled water with the barometer at 30 inches and the thermometer at 62 degrees Fahrenheit.

The U.S.A. gallon contains 231 cubic inches and holds 8.33 lb. of water so that 71 U.S.A. gallons are approximately equal to 59 Imperial gallons.

The Bushel.—The Imperial bushel contains 8 gallons, 1.28 cubic feet or 2219.3 cubic inches. The U.S.A. or Winchester bushel contains 2150.4 cubic inches.

The bushel is a measure of volume or capacity, not of weight. A bushel of wheat, for instance was originally the quantity of wheat required to fill a bushel measure. The size and density of the grains the percentage of moisture content, the degree of admixture of such things as chaff, weed seeds, dust, etc., could obviously cause fairly wide variations in the actual weights of a series of measured bushels of wheat from different sources. The weight of a measured bushel of apples, bran, oats or barley would differ from the weight of a measured bushel of wheat.

For convenience in trading, certain weights have been accepted as approximating the average weight of a bushel of various forms of farm produce.

Some of the common examples are given below:

	lb.
Apples	42
Beans (dry)	60
Beans (French, green)	20
Bran	20
Grass Seeds	20
Lemons	48
Lucerne Seed	60
Maize	56
Millet	60
Oats	40
Peas (Field, dry)	60
Pollard	20
Wheat	60

MEASURES OF WEIGHT

The Avoirdupois Table of weights, given below, is used in most commercial transactions throughout the British Commonwealth of Nations.

16 drams (dr.) = 1 ounce (oz.).
16 ounces = 1 pound (lb.).
14 pounds = 1 stone (st.).
2 stones = 1 quarter (qr.).
4 quarters = 1 hundredweight (cwt.).
20 hundredweights = 1 ton.

The Ton (2,240 lb.) is sometimes referred to as the "long ton" to distinguish it from the "short ton" or "U.S.A. ton" (2,000) used in flour sales.

The Cental (100 lb.) is another unit of weight often quoted in overseas grain and flour sales.

The Quintal is a term with variable meanings. In the U.S.A. it is 100 lb.; in Britain 112 lb. or 1 cwt.; and in the Metric system it means 100 kilogrammes (220.46 lb.).

TROY WEIGHT

Gold, silver and precious stones are weighed by the Troy Weight given below—

24 grains (gr.) = 1 pennyweight (dwt.).
20 pennyweights = 1 ounce (oz.).
12 ounces = 1 pound (lb.).

The Carat (3.2 gr. Troy) is used in weighing diamonds, but a carat of gold, used as a measure of fineness, is 10 dwts. (a twenty-fourth part of 1 lb. Troy). All alloyed gold is regarded as being divided into 24 equal parts so that 18 carat gold is 18 parts of pure gold to 6 parts of alloy (usually copper) 12 carat is 12 parts of pure gold to 12 parts of alloy, and 9 carat, is 9 parts of gold to 15 parts of alloy.

APOTHECARY'S MEASURES

Although drugs are bought and sold by Avoirdupois weight, prescriptions are dispensed by the Apothecary's weights and measures given below—

Weights

20 grains (gr.) = 1 scruple (sc.).
3 scruples = 1 drachm (or dram.).
8 drams = 1 ounce.

Fluid Measure

60 minims = 1 fluid drachm.
8 fluid drachms = 1 fluid ounce.
20 fluid ounces = 1 pint.

A Minim is approximately one drop, although measurement by drops is neither safe nor accurate. The consistency of the liquid and the size and shape of the neck of the bottle can cause wide variations in the size of the drops.

Household Measures.—Because of the varying size of household utensils they should not be used for measuring medicines. A graduated medicine glass marked off in teaspoonfuls, dessertspoonfuls and tablespoonfuls may be purchased cheaply.

A medicinal teaspoonful = 1 fluid drachm.
A medicinal dessertspoonful = 2 fluid drachms.
A medicinal tablespoonful = ½ fluid ounce.

Coins as Weights and Measures

A halfpenny is one inch in diameter.
Three pennies weigh one ounce.
A halfpenny and a threepenny piece weight ¼ oz.
A florin and a sixpence weigh ½ oz.

(The weights of coins are taken on coins that are neither brand-new nor badly worn.)

THE METRIC SYSTEM

The metric system, in which all the weights and measures are in fractions or multiples of ten, has obvious advantages and has been adopted by many countries throughout the world.

The metric system is based upon the "metre" which is one ten millionth part of the distance from the Equator to the North Pole on the meridian of Paris. The metre equals 39.371 inches and is the basic unit of length.

Similarly, the unit of area or square measure is the "are" (a surface measuring 10 metres x 10 metres).

The metric table of weights is based on the "gramme" which is the weight of water (at its greatest density) which could be contained in a cubical vessel with sides measuring one-hundredth part of a metre (one centimetre).

The metric unit of volume or capacity is the "litre" which is the contents of a cubical vessel with sides measuring one-tenth part of a metre (one decimetre).

The Latin prefixes *deci, centi, and milli* are used to denote **fractions or parts** of the

units (a tenth, a hundredth and a thousandth respectively).

The Greek prefixes *deca, hecto, kilo and myria* are used to denote **multiples** of the units (ten, a hundred, a thousand and ten thousand times respectively).

Approximate British equivalents are given in brackets alongside the main metric weights and measures.

LENGTH (Metric)

10 Millimetres = 1 Centimetre (0.394 in.).
10 Centimetres = 1 Decimetre (3.987 in.).
10 Decimetres = 1 METRE (39.371 in.).
10 Metres = 1 Decametre (10.936 yds.).
10 Decametres = 1 Hectometre (109.363 yds.).
10 Hectometres = 1 Kilometre (1,093 yds.).

WEIGHT (Metric)

10 Milligrammes = 1 Centigramme (0.154 grains).
10 Centigrammes = 1 Decigramme (1.543 grains).
10 Decigrammes = 1 GRAMME (15.432 grains).
10 Grammes = 1 Decagramme (154.323 grains).
10 Decagrammes = 1 Hectogramme (3.527 oz.).
10 Hectogrammes = 1 Kilogramme (2.205 lb.).
100 Kilogrammes = 1 Quintal (1.968 cwts.).
10 Quintals = 1 Tonne (0.984 ton).

CAPACITY (Metric)

10 Millilitres = 1 Centilitre (0.017 pints).
10 Centilitres = 1 Decilitre (0.176 pints).
10 Decilitres = 1 LITRE (1.761 pints).
10 Litres = 1 Decalitre (2.201 gals.).
10 Decalitres = 1 Hectolitre (22.009 gals.).

SOME FACTS ABOUT WATER

Water covers approximately four-fifths of the surface of the globe and makes up a similar proportion of the total mass of animal and vegetable matter on the earth.

It boils at—
212 degrees Fahrenheit.
100 degrees Centigrade.
80 degrees Reaumur.

It freezes at—
32 degrees Fahrenheit.
0 degrees Centigrade.
1 degree Reaumur.

When water is cooled, it shrinks in volume until it reaches a temperature of 4 degrees Centigrade (which equals 39.2 degrees Fahrenheit). It then commences to increase in volume as the temperature is lowered and, when the formation of ice takes place at 0 degrees Centigrade (32 degrees Fahrenheit), a considerable expansion—equal to about one-eleventh of the bulk of the water—takes place.

Weight of Water.—An easily-memorised jingle is—

"A pint of pure water
Weighs a pound and a quarter."

A gallon of water weighs 10 lb.

A cubic foot of water contains 6¼ gallons (approx.) and weighs 62½ lb. (1,000 oz.) if fresh or about 64 lb. (1,024) oz. in the case of sea water.

It takes approximately 11 gals. of water to weigh a hundredweight or 224 gals. to weigh a ton.

A fluid ounce of water weighs 1 ounce Avoirdupois.

Rainfall.—An inch of rain deposits about 22,687 gallons or 101 tons of water on each acre of ground. For convenience, it is usually calculated at 22,400 gallons or 100 tons per acre-inch.

Farm Water Supplies.—The ideal water supply is one in which the water is clear, sparkling and odourless, free from disease-producing organisms and from mineral salts which cause "hardness."

Rainwater closely approaches the ideal but is not normally available in sufficient quantities to supply all requirements of livestock, etc.

Surface waters such as are found in streams, lakes and farm dams are usually fairly free from mineral salts but may contain substances which cause them to be cloudy or discoloured.

Underground waters from wells and bores vary widely in their mineral contents and are often unsuitable for human consumption but may be quite satisfactory for livestock.

Water for Livestock.—No hard-and-fast rules can be laid down regarding the permissible quantities of mineral salts in stock waters but a useful and easily-memorised guide is that "Good" stock water contains less than 300 grains of total salts per gallon. Water containing up to 600 grains could be classed as "Fair" and anything with over 600 grains as "Bad."

In practice there are wide variations in the tolerance of stock to mineralised waters. Stock on ample green feed for instance can withstand higher concentrations of mineral salts than those on dry feed. Where evaporation from a dam gradually increases the saline content of the water stock may continue to thrive although new stock, used to fresh water, would be injuriously affected if suddenly switched to such a source.

Sheep are more tolerant than cattle and horses and have been known to remain healthy when drinking water containing over 1,000 grains per gallon of total salts. Maximums often quoted for other stock are, 700 grains for beef cattle, 500 grains for dairy cattle, 450 grains for horses, 300 grains for pigs and 200 grains for poultry.

Dry stock and adult animals can usually tolerate saline water better than lactating animals and young stock.

Mineral Salts.—About three-quarters of the total salts in the water of the agricultural areas in Western Australia consist of sodium chloride (common salt). The proportion of common salt is less in the pastoral areas and northern part of the State.

Other salts include gypsum (calcium sulphate), epsom salts (magnesium sulphate), Glauber's salts (sodium sulphate) and other salts of soda, lime and magnesia.

For human beings a maximum total salts content of 150 grains per gallon is usually quoted. The total salts content of of the water supply for the metropolitan area varies according to locations and seasons. That from the Hills reservoirs has about 15 grains to the gallon but in certain seasons this supply is augmented by bore water carrying up to 80 grains.

Sea water carries about 2,500 grains to the gallon of which about 1,900 grains is common salt.

About 220 grains of total salts per gallon is regarded as the maximum for safe watering of plants but where such a concentration is used there should be good drainage and waterings should be sufficient to leach accumulated salts below the root zone.

One ounce (Avoirdupois) equals 437½ grains.

Beekeeping is the agricultural industry which has made the most growth since the end of the war in Western Australia. This increase has been due to the high yields obtained from our native plants. But accompanying this advantage is the need for frequent, long-distance shifts of truck loads of hives.
The illustration shows a truck making a break in a long haul by stopping during the day to allow the bees to fly. The beekeepers loaded the hives the previous day and drove during the night to an outer suburb of Perth. The truck was parked underneath a shady sapling, and the beekeepers slept during the day while the bees flew and foraged for water. When evening came the beekeepers moved off, on the second leg on a long haul.
Sometimes a thousand mile round trip between their summer and winter areas with each load of bees is made.

Never before . . . a tractor like this!

You will be astounded at the sheer lugging power of the new 35 diesel. Look at the way it pulls that 5-furrow plow 6" deep through heavy loam in third gear with power in reserve. Right through the gear range, right through the speed range the great-hearted new M F 3A152 37 H.P. engine keeps pulling under loads that stop other tractors short. Wherever the new 35 has been demonstrated farmers have been amazed at its pulling power. Their unanimous opinion is "there's never been anything like it. You've got to see it to believe it!"

THE WORLD-LEADING 35 DIESEL TRACTOR NOW PACKS MORE FEATURES THAN EVER—

New chrome plated cylinder liners to increase bore life up to 50%.

New easy starting by a combination of direct and indirect injection plus larger bore . . . the easiest starting ever developed . . . makes auxiliary starting aids virtually unnecessary.

New enlarged fuel tank of 8½ gallons capacity.

New fuel economy, because better torque characteristics enable you to work in higher gears under load.

New heavy duty dual clutch fitted to the deluxe model is the heaviest, most robust type ever fitted to any medium tractor.

New single battery installation.

New power-packed combination — exclusive Ferguson System teamed with great lugging power gives you a power combination that leaves bigger tractors standing.

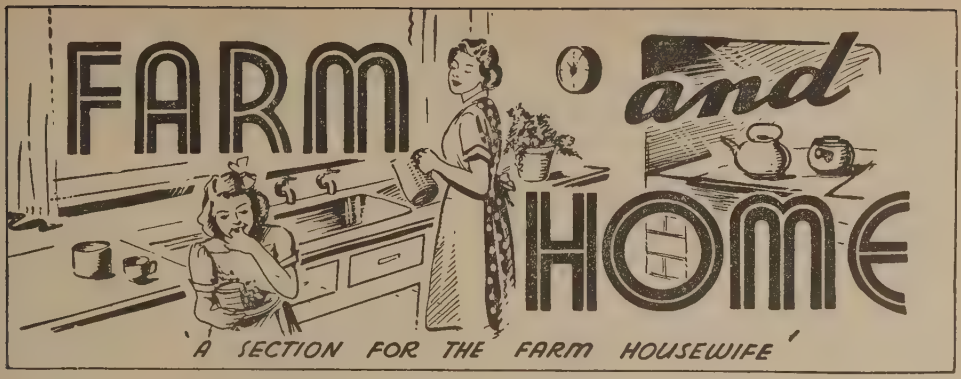
Ask for a Demonstration and make this Test

Overload the engine, close the throttle, see it keep lugging down to idling speed — then open the throttle and see it recover quickly to maximum power. No wonder it's been dubbed "the tractor with the engine that won't give in."

TR3636/8

M F 1960 MODEL MASSEY-FERGUSON 35 DIESEL

MASSEY-FERGUSON (AUSTRALIA) LIMITED, SUNSHINE, VICTORIA. BRANCHES IN ALL CAPITAL CITIES



Lamb for Good Living

By HELEN M. GLOSTER

LAMB is at its best in the spring. With careful planning the housewife is able to serve it in a large variety of ways. The favourite meal is Roast Lamb, or to be more correct baked lamb. Usually the forequarter or leg is baked. For a small roast, a piece of loin or part of the leg may be cooked.

If mutton is baked, the shoulder or loin are the best cuts.

Try these accompaniments with the lamb: Potatoes, young parsnips and carrots baked with the meat; tender green peas (save the water for making the gravy); brown gravy and mint sauce.

BOILED LAMB (or Mutton)

A piece of the neck end of the forequarter or the leg are suitable cuts for boiling.

Root vegetables (other than potatoes) may be cooked in the saucepan with the meat. The vegetables not only absorb some flavour **from** the meat, but impart flavour **to** the meat. Include as many of these as you have available:—onions or leeks, carrots, parsnips, turnips, swedes, celery.

The liquid in which the meat and vegetables have been cooked should be kept and allowed to cool. Skim off the fat and use the liquor (stock) as a foundation for soups, gravies, stews.

Boiled lamb is served with a mask of white sauce. The sauce is made slightly thicker than a sauce used for pouring. It may be varied in flavour by the addition of one of the following:—

Finely chopped parsley, diced hard boiled egg, chopped onion or capers.

Boiled lamb will cook in a shorter time than boiled mutton, as the meat is already tender.

To Serve.—This dish on its own is rather colourless in appearance. When serving, brighten the effect of the dish with carrot, parsley and a good green vegetable—spinach, sprouts or cabbage. These all lift the otherwise colourless flat appearance.

PARSLEY SAUCE

Ingredients.

1 pint white sauce (use half milk and half liquor in which meat was cooked).

2 tablespoons **finely chopped** parsley; pepper, salt to taste.

Method.

Add parsley to sauce just before serving.

Pour sauce over meat before serving.

Arrange root vegetables on the meatdish as a garnish.

ONION SAUCE

Ingredients.

1 pint white sauce.
2 tablespoons cream (if liked).
2 or 3 onions (cooked with the meat).
Pepper and salt to taste.

Method.

Chop onions coarsely, and add to sauce.
Simmer two or three minutes.
Stir in the cream just before serving.

CAPER SAUCE

Ingredients.

1 pint white sauce.
2 tablespoons capers.
1 tablespoon vinegar (from the bottle of capers).
Salt and pepper to taste.

Method.

Make the sauce.
Cut capers in two or chop coarsely.
Stir the sauce into the capers and vinegar.
Season, then pour over the meat.

EGG SAUCE

Ingredients.

1 pint white sauce.
1 teaspoon lemon juice.
Salt and pepper to taste.
2 or 3 hard boiled eggs.

Method.

Hard boil the eggs and stand in cold water.
Make the sauce.
Remove the shells and cut the whites of the eggs into small dice, and mash the yolks.
Stir hot sauce into diced white of egg, seasoning and lemon juice and serve with mashed yolk sprinkled on top as a garnish.
N.B.—Mashed yolk may if preferred be incorporated in the sauce with the whites of eggs and seasonings.
Important.—Remember to skim the liquid in which the meat was cooked before using it for sauces or any other dish. Liquid fat is very indigestable.

LAMB PIE

Ingredients.

1½ lb. leg chops.
1 white onion.
2 hard-boiled eggs.
½ cup vegetable water or stock.
2 tablespoons plain flour.
1 tablespoon chopped parsley.
½ teaspoon grated lemon rind.
Salt and pepper.
Rough puff or flaky pastry (6 oz. flour).

Method.

Cut meat into neat serving portions and remove fat.
Add sliced onion, salt, pepper, water or stock and simmer gently for one hour.
Allow to cool, skim off fat.
Stir in blended flour, chopped parsley and grated lemon rind.
Arrange in a pie dish and place sliced hard boiled eggs on top.
Make pastry, cover the pie and decorate.
Glaze with beaten egg or milk.
Bake in a hot oven until pastry is well risen and browned, then in a cooler oven until pastry is well cooked.
N.B.—If mutton is used, meat will require longer cooking.

SQUAB PIE

Ingredients.

2 lb. neck chops (lamb or mutton).
2 lb. apples.
1 lb. onions.
1 tablespoon of mushroom ketchup or dehydrated mushroom soup.
¾ cup vegetable water (boiling).
Sugar.
Salt.
Pepper.
Suet pastry (6 oz. flour).

Method.

Divide chops into serving portions and place them in a pie dish and season with salt and pepper.
Slice apples and onions and place a layer of each on top of the meat.
Sprinkle with sugar.
Make the suet paste.
Half fill the pie dish with boiling vegetable water, just before adding suet crust.
Cover with crust and bake in a hot oven.
Reduce the heat when crust is brown and continue baking for 1½ hours.
Before serving, pour off gravy, skim, add ketchup, then return to pie dish. If dehydrated soup is used, it should go into the pie before being covered with paste.
N.B.—Gravy may be thickened, if preferred.

SUET CRUST

Ingredients.

6 oz. plain flour.
2 level teaspoons baking powder; or 6 oz. self-raising.
3 oz. beef suet.
¼ teaspoon salt.
Water to mix.

Method.

Sift flour and salt.
Shred suet and chop finely, using some of measured flour.
Add remainder of flour.
Mix to a light dough, using a knife.
Turn on to a floured board, knead slightly.
Use as required.
N.B.—Short pastry may be used instead of suet paste for Squab Pie.

LAMB CUTLETS IN PAPER

Ingredients.

6 lamb cutlets.
12 small pieces of bacon rashers.
1 shallot.
1 tablespoon chopped parsley.
Grated lemon rind.
Salt and pepper.

Method.

Take six pieces of greased grease-proof paper (butter wrappers will serve the purpose).
Place a piece of bacon rasher on each paper.
Sprinkle with chopped parsley, grated rind of lemon, pepper and salt.
Place a cutlet on top of each then sprinkle with mixture (parsley seasonings) and finish with another piece of bacon.
Wrap each cutlet up separately in paper.
Place in a greased baking dish and bake in a moderate oven half to ¾ of an hour.
Serve hot with baked jacket potatoes and green peas.
Sauce may be served with this dish if liked.
When available, a few chopped mushrooms may be added when preparing the layers, before wrapping.

CRUMB CUTLETS

Ingredients.

Trimmed lamb cutlets.
1 egg.
Dry breadcrumbs.
Pepper and salt.
Fat for frying.

Method.

Trim the cutlets, removing as much fat as possible.
Beat egg, season with pepper and salt. Egg will go further by adding a tablespoon of milk if necessary.
Dip each chop into egg, drain and cover with dry breadcrumbs.
Press with knife, then shake off surplus crumbs.
Heat a little fat in frying pan until a blue fume rises and surface of fat is perfectly still.
Fry cutlets quickly on each side until well browned then fry slowly until cooked through (15 minutes altogether).
Drain on kitchen paper.
Serve on a hot meat dish with a white paper frill around the bone of each cutlet. Serve with mashed potatoes, green peas and grilled tomatoes, tomato puree or hot tomato sauce.

FREE SERVICE TO FARMERS

Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 946/7.

These officers are there to help you and will make personal visits to your property to assist with on-the-spot advice. In addition, they will, where necessary, arrange for the services of specialist officers—all without cost to you.

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D836

MILK FEVER
(HYPOCALCAEMIA)
of COWS

THE condition known as milk fever is almost essentially a disease of highly productive adult milking cows at the time of calving. It is characterised by a low blood calcium level causing a sudden general depression of consciousness of the cow and muscular paralysis. Without treatment most cases result in the death of the cow.

OCCURRENCE

Milk fever mainly occurs in mature cows between five and ten years of age; that is during the period of highest milk production. The disease is not often seen in beef cows and is very rare in heifers. Of breeds; the higher butter fat producing cows are more susceptible so that the disease is more commonly seen in the Channel Island breeds than in Holsteins. The season of the year also affects the occurrence with more cases in the winter and spring months.

The great majority of the cases of milk fever occur within the first three days after calving and the animal may become affected at any time during this period. Exceptionally, the attack occurs immediately before calving, or even while calving is actually in progress. This disease is not, however, wholly confined to the parturient period. Occasionally it affects animals which have been milking for a period of weeks or months. These cases of so-called "Delayed Milk Fever," mainly occur when cows are running on succulent pastures, and are often associated with the period when the animal is in season.

CAUSE

The actual cause, a fall in blood calcium, is known but the reason for this fall in blood calcium is not known.

Milk and more especially colostrum is very rich in calcium. Now, analyses have shown that ½ a gallon of colostrum contains as much calcium as is present in the cows blood stream at any one time. Therefore, the cow following calving has to be continuously replenishing its blood calcium from large amounts of calcium stored in the bony structures of the body. In some high producing cows, for a reason unknown this replenishment of blood calcium is not rapid enough and blood calcium levels fall with the resulting symptoms of milk fever.

The term milk fever is rather a misnomer as there is no fever, in fact the body temperature is usually lower than normal.

The term hypocalcaemia, that is low blood calcium, is much more applicable.

SYMPTOMS

The chain of symptoms shown as a result of the low blood calcium can be divided for convenience into 3 stages.

First stage.—The cow still standing becomes depressed and ceases to eat or chew its cud. If forced to walk it appears stiff in the hindquarters and definitely unsteady on its feet. Rarely, there is an initial period of excitement with twitching all over.

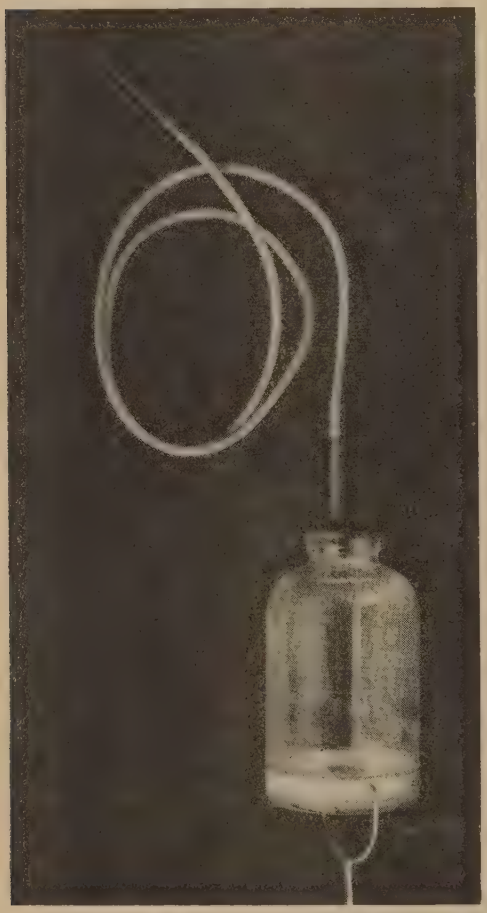
Second stage.—The cow is seen recumbent in a characteristic pose lying awkwardly on her brisket with her head bent around towards the flank and resting on her shoulder.

Third stage.—The cow lying flat on its side, perfectly relaxed and in a coma. There is no response to stimuli such as prodding.

Symptoms common to stage 2 and 3 are that the eyes and muzzle are dry and the cow is usually constipated. The breathing is changed and can either be deep and laboured or shallow and frequent. There

is commonly moaning with breathing as if the cow is in pain.

If allowed to progress without treatment bloating occurs which restricts breathing so that from a distance the cow appears dead. At this stage fluid contents of the stomach often run out the nose and mouth. Without treatment the cow will die once she reaches this stage.



An outfit for administering calcium borogluconate solution

TREATMENT

Treatment is relatively easy, cheap and highly effective if given early. If the cow is bloated and there is the appearance of stomach fluids then treatment is not always so successful.

Two methods of treatment are available:—

(1) The subcutaneous injection of calcium borogluconate solution.

(2) Inflation of the udder with air.

The calcium injection is preferable to udder inflation on account of the fact that it obviates the risk of mastitis and is not accompanied by a decrease in milk yield. Udder inflation should only be used in emergency when calcium injections are not available.

1.—The Injection of Calcium Borogluconate Solution.

This is the obvious method to quickly restore the blood calcium level back to normal.

The solution for injection can be prepared by stirring a mixture of three ounces of calcium gluconate and three drachms of boric acid (8 drachms = 1 ounce) into 1 pint of boiling water until it is completely dissolved. The solution should be allowed to cool to blood heat before injection, and the whole of it administered at one treatment. Making for greater convenience, calcium borogluconate may be purchased in carton form. Each carton contains the requisite dose of the drug which when dissolved in a given amount of water produces a solution which is immediately ready for use. An even more convenient form is the calcium borogluconate solution already for injection. This solution does not deteriorate and can be kept indefinitely.

As it is necessary to administer a relatively large quantity of calcium borogluconate solution it is advisable to employ an outfit which will enable the injection to be made quickly and efficiently. An injector which will be found suitable for this purpose, and which may be made up at a comparatively small cost, is reproduced in the diagram. A rubber enema syringe will serve quite well as an air pump. When air is forced into the bottle by pressure on the rubber bulb the solution is forced out and flows freely through the needle.

Another apparatus that is very useful is the flutter valve which can be used as shown in the accompanying photograph. It is essential for this apparatus that you

have a large needle. A 12 or 13 guage is best.

The injections should be given at two points along the neck or behind the shoulder, approximately six ounces of the solution being injected beneath the skin at each of the sites selected. The needle and tubing should be sterilised by boiling before use. The hair over the site of the injection should be clipped and the skin cleansed by swabbing with methylated spirits. In making the injection a fold of skin should be taken up between the fingers and penetrated by a thrust with the needle which can afterwards be felt lying immediately beneath the skin. After injecting the fluid gently massage the area of injection. This will help to avoid abscess formation, and give faster absorption of the calcium.

In cases in which the cow shows some excitement 2/3 of an ounce of magnesium sulphate should be added to the calcium solution. When the injections have been completed the cow should be propped in the natural recumbent position and supported by bags of earth or sand placed alongside the shoulder.

The response being usually fairly rapid the cow should start to sweat at the nose and tremble. She often passes dung, and soon after this commonly rises. The breathing becomes steadier and the cow may belch up gas. The cow should be normal in six hours if not she should be given another injection.

The recovered cow should be encouraged to eat and drink. If the cow fails to return to normal eating habits she should be drenched with molasses (1 or 2 lb.) or glycerine 2 pints a day for three days.

Cows which become bright again but cannot or will not rise are a problem, as there is usually some complicating injury to the limbs which has occurred when the muscles were relaxed during the hypocalcaemia or a secondary infection has occurred. They should not be given further calcium injections as too much calcium can cause death. Some sulky cows will not attempt to rise following apparently successful treatment. There are all types of methods suggested for stirring these animals to their feet, such as a barking dog or rubbing the tail between your boot and a piece of hard material. The most enterprising method suggested would appear to be a cat dragged by the tail backwards along the cow's back, the cat's sharp claws causing the cow to rise. This is not however, a Departmental recommendation.

One important after treatment point is do not milk the cow out following recovery. Ease only at the first milking and gradually increase the amount of milk taken at the next couple of milkings.

Use of a flutter valve apparatus

2.—The Inflation of the Udder with Air.

This method consists of inflating each of the four quarters with air, until they are firmly distended. A milk fever outfit is used for this purpose. This consists of a pump similar in type to a bicycle pump to which is connected in series an air filter, and a teat syphon (tube).

Immediately before use, the air filter and teat syphon are sterilised by immersion for ten minutes in boiling water, and the air filter, which consists of a hollow metal cylinder, is packed with dry cotton wool. Meanwhile, the udder is prepared by thorough washing with an antiseptic solution such as lysol or dettol in the strength of two ounces to five pints of water, and a cloth which has been steeped in this solution and then wrung out is placed beneath it.

The sterilised teat syphon is now introduced into the teat canal and air is pumped in until the quarter is firmly distended. Each quarter in turn is dealt with in this manner and when the inflation is completed the teats should be grasped firmly and the udder massaged. It is a

common practice to ligature the teats with tapes for a period of two or three hours to prevent an escape of air.

This procedure, however, is unnecessary, and it may lead to the development of a troublesome stricture, if the tapes are allowed to remain in position too long.

In carrying out this treatment great care should be exercised in the sterilisation of equipment and the cleansing of the udder and teats, otherwise infection will be introduced into the udder, which may result in an attack of mastitis.

Recovery should occur within a few hours. If the cow does not improve then inject calcium solution as described.

PREVENTION

Many methods have been tried to prevent milk fever in susceptible cows such as feeding high calcium diets, large doses of vitamin D in the feed, some animal protein added or diets high in phosphorous and low in calcium for a month before milking. All however, are of doubtful value and not generally recommended.

Two methods of prevention which appear to have some merit are delayed milking or removing only a part of the milk from the udder for the first few days and/or a calcium injection immediately after calving in those cows very susceptible to milk fever.

Leave those Waterways Uncultivated

If water runs on to your property from roads or neighbouring properties it is UP TO YOU to make sure it runs over permanently uncultivated soil. All depressions should be left as uncultivated waterways otherwise they will have to be left in the future as erosion gullies. The waterway running down the centre of the picture has been left untouched. It is well grassed and unlikely to form an erosion gully.

Produce your toughest conditions — ***THEY WON'T STOP THIS TRIO!***

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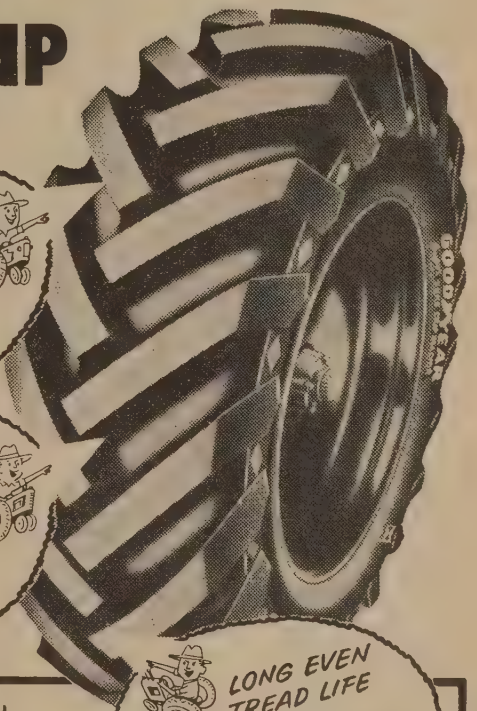

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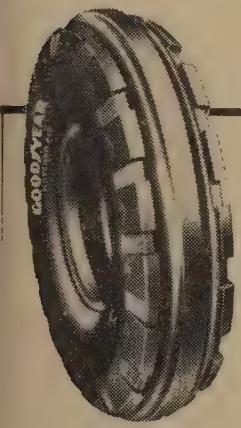

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MORE FARMERS PREFER GOODYEAR TRACTOR TYRES THAN ANY OTHER KIND!

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Honey Flora Calendar for December

COMPILED BY R. S. COLEMAN, APICULTURAL SECTION, WITH ASSISTANCE FROM THE BOTANICAL BRANCH

Common Name	Botanical Name	Where Found	Honey		Quality of Pollen	Remarks
			Quality	Quantity		
Snap and Rattle, Yorrel, Small-budded Mallee	*Eucalyptus gracilis*, F. Muell.	Widespread throughout the wheat belt. Range from Great Southern, Salmon Gums to Karoo	Good	Good	Good	Very different reports about this tree from various areas. Some areas report excellent flows and high quality honey in others the tree is not regarded as a nectar-bearing tree at all.
York Gum	*Eucalyptus loxophleba*, Benth.	From the Murchison River on the road to Carnarvon to the Great Southern, Salmon Gums	Good	Excellent	Poor	Major honey plant, but is deficient in pollen. When the Cape Weed is in flower the bees will produce quite a lot of surplus. Bud development is about 9-10 months. As it grows on good agricultural areas most of it has been cleared.
White Gum or Wandoo	*Eucalyptus redunca*, Schau.	Spring White Gum is found mainly on the tops of hills. Starting mid-September and going through to Xmas time in the area from Bolgart to Wandering	Excellent	Excellent	Poor	Flowers well into late spring or early summer and it seems to be open first on the gravelly hills in the Dale, York and Dalwallinu areas.
Chittick	*Lambertia inermis*, R.Br.	Southern sand plain	Good	Good	Good	Flowers most of the year with its flush period in spring Regarded as a good flower by local beekeepers.
Lemon-scented Gum	*Eucalyptus citrodora*, Hook.	Planted extensively around Perth. A native of N.S.W.	Good	Good	Good	A number of beekeepers have reported flows from this source.
Clelands Blackbutt	*Eucalyptus Clelandi*, Maiden		Unknown	Unknown	Unknown	From reports from non-beekeepers, this could be one of our future honey plants.
Rough Fruited Gum	*Eucalyptus corrugata*, Luehm.	Grows between Westonia and Southern Cross	Unknown	Unknown	Unknown	From reports from non-beekeepers, it is a long flowering tree and attracts considerable attention from birds.
Yellow Tingle	*Eucalyptus Guilfoylei*, Maiden	Southern coastal lands, forests, usually found on river, creek banks and valleys	Good	Good	Good	This tree has been reported as a most unreliable producer as it seems to be sensitive to cold weather.
Lerp Mallee	*Eucalyptus incrassata*, Labill	Widespread	Good	Good	Good	Many different reports. Information is needed on this plant to correct information we have already.

Angular Mallee	*Eucalyptus incrassata*, Labill. Var. *angulosa* or *E. angulosa*	Widespread	Good	Good	Good	Reported as a good honey producer in the Eastern States. Is not worked by beekeepers here.
	Eucalyptus leptophylla, F. Muell.	Widespread	Good ? .	Good ? .	Good ? ...	Differing reports, most of them saying this tree is of little use to the beekeeper. Honey flow thin and light in colour with mild flavour.
Jarrah	*Eucalyptus marginata*, Sm.	One of the main forest trees in Western Australia	Good ...	Good .	Excellent ..	One of the major honey plants. It needs a wet spring to set its buds. A dry but humid early summer to produce heavily. The coastal Jarrah seems to produce better than hills Jarrah.
Crown Top Mallee	*Eucalyptus pileata*, Blakely	. . . . ..	Unknown ...	Good ? .	Good	One of the varieties we need more information about. Some good reports.
Diamond Bush ..	*Bossiaea Laidlawiana*, Tovey et Morris	In the Karri forests . .	Good .	Good ..	Excellent	One of the best pollen plants we have here in Western Australia. Its main disadvantage is that it tends to make the hive swarm.
Honeysuckle	*Lambertia multiflora*, Lindl.	....	Good ?	Good ?	Good	Red flowers on the sand plain and yellow flowers in the Darling Range and south.
Silver Banksia or Yellow Banksia	*Banksia attenuata* R.Br.	Sand plain	Good	Good	Good	Regarded as a very good producer by those beekeepers who live in the area where it grows.
Boree Paper Bark	*Melaleuca pauperiflora*, F. Muell.	....	Good	Good	Good	Not extensively worked by beekeepers.
Taylorina	*Psoralia pinnata*, Linn.	Albany area	Excellent	Excellent ..	Excellent	Connoisseur's honey. Very limited area. The honey is greatly sought by those who appreciate good honey.
Karri .	*Eucalyptus diversicolor*, F. Muell.	Main Karri area	Excellent ...	Excellent	Excellent .. .	The major flow starts in November-December. However, if bees are taken down in this time into the forest the intermittent flow from the Karri due to rain will cause excessive swarming.
Wild Hops	*Chorilaena hirsuta*, Benth.	Karri area ..	Good . ..	Good	Good	Bees work this in the rain as flowers are abundant. 56 lb. is the average usual from this flow. The activity of bees on this flow seems to be associated with the weather conditions. Flowers over a long period.
Sand Plain Woody Pear	*Xylomelum angustifolium*, Kipp	....	....	....	....	Excellent pollen yielder.

It will be seen from this list that information concerning many nectar-bearing plants is far from adequate. We would appreciate further information from beekeepers.

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BITTER PIT

A PROGRESS REPORT ON THE USE OF CALCIUM NITRATE SPRAYS FOR ITS CONTROL

by

F. MELVILLE, B.Sc. (Agric.), Adviser (Fruit)

and

S. E. HARDISTY, B.Sc. (Agric.), Adviser, Bridgetown

FREEDOM from serious pests and diseases such as Black Spot and Codling Moth and relative immunity from storage rots has greatly simplified apple growing in Western Australia. However, what has been gained in this respect is often countered by pre-harvest and post-harvest physiological troubles which are rather common to apple growing in this State.

Over the years the disorder which has remained a problem and in some years caused widespread losses is Bitter Pit. The incidence of pit varies considerably from year to year, from orchard to orchard and from tree to tree but almost invariably it will show up in some degree on Cleopatras and in Granny Smiths and Golden Delicious in light crops and on young trees.

Fruit of these varieties was particularly prone to pit during the past season which was probably comparable with some of the worst years experienced in the past.

Visible losses commence at harvest with rejections for tree pit in the orchard, and continue on the sorting table, but probably the most serious economic loss is when after handling, packing and cool storage charges have been incurred, the fruit is rejected for export. Returns on the local market under such conditions often fail to cover the costs involved. Where susceptible fruit does get away it creates an unfavourable impression overseas.

Although pit rejections for Cleos were high during the 1960 export season it is well to note that the allowable tolerance for pit was no different from previous years. Increased rejections of fruit destined for Scandanavia resulted from the compulsory storage of Cleos for one week before inspection, but by this means fruit which could only have brought bad outturn reports was held back.

PIT LIABILITY

Growing conditions in Western Australia accentuate the pit problem. The summer is normally hot and dry with many sunny days and hot drying winds which combine to produce permanent drought or temporary physiological drought within the trees. That is a situation develops in which the leaves are transpiring water at a greater rate than the roots can absorb it and a water deficit is developed within the tree.

The majority of Cleos are growing without irrigation and this further accentuates the drought effects.

Pit develops as a result of localised water deficits in the maturing fruit resulting in collapse of certain tissue which subsequently discolours and forms the brown depressed areas we know as pit. Apart from surface pits the disorder often extends in the form of small localised areas of brown tissue scattered through the flesh.

The water deficit may occur while the fruit is still on the tree as the result of excessive moisture loss from the foliage producing the tree pit seen at harvest. Some of the necrotic areas may not be readily visible at this time but develop in the early storage period. Water shortage in certain tissue may also occur during ripening due to uneven conversion of starch to sugar. In varieties which are pit liable the loss of starch from the tissue

occurs very unevenly as the fruit matures. Water is required for the process of changing starch to sugar and as the sugary tissue has a greater attraction for water, areas of acute water shortage will develop in the high starch areas. This condition results in the formation of storage pit, a series of dark brown depressed spots located towards the calyx end of the fruit.

Low humidity in cool store will accentuate pit and under Western Australian conditions low temperatures appear to increase the disorder. By slowing down the rate of ripening, cool storage will increase pit apparently by prolonging the period during which conditions for pit development are present.

Conditions in the orchard which accentuate pit are periods of serious competition between leaves and fruit for moisture. Anything which induces excessive growth such as pruning, heavy nitrogen usage, young trees or ideal summer growing conditions such as occurred last season and particularly if associated with light crops, will render the fruit pit liable. With trees carrying good crops adequate irrigation appeared to greatly reduce pit in the past season.

Storage pit is most likely to occur in fruit with excessive starch, that is fruit picked immature or where for some reason the conversion of starch to sugar is slow. This is the case with light crop fruit and may also have been a factor in the prevalence of pit last season.

The only means available in the past for reducting pit have been to limit excessive tree vigour, pick at the correct stage of maturity and only store fruit from good crops off mature trees. Irrigation appears to have a beneficial effect in reducing pit and thinning out fruit clusters by hand or by the use of chemical thinning sprays has proved worthwhile.

CALCIUM DEFICIENCY

Calcium is known to be an important element in cell wall construction and is necessary for normal cell functions.

Localised calcium deficiency in the cells of the fruit is thought to be related to the cell collapse responsible for the development of pit. It has been suggested that moisture stress actually produces a localised calcium deficiency in the subsequently disease cell areas.

The effect of calcium nitrate foliage sprays in reducing blossom end rot in tomatoes, a somewhat comparable disorder, resulting from physiological drought conditions in the tomato plant, attracted attention to the use of this material for the control of bitter pit in apples. Field trials were therefore conducted with Cleopatras during the 1959-60 season incorporating suggestions made by Dr. D. Martin of Tasmania who has had considerable success with these sprays.

CALCIUM NITRATE SPRAY TRIALS

The south-west was selected as a suitable area for this work and blocks of Cleos were chosen on the properties of W. Della Polina & Son, Bridgetown, and M. C. Fry & Sons, Donnybrook.

Five trees were included in each treatment and randomised.

Treatments were as follows:—

(1) Borax at 1 lb. per 100 gallons of water applied at full blossom.

(2) Calcium nitrate at 16 lbs. per 100 gallons of water applied at—

  (a) Bridgetown on 15th November, 1st January, 11th January.

  (b) Donnybrook on 15th November, 1st December, 1st January.

  (c) Bridgetown on 1st January, 11th January, 25th January —Triton at the rate of 4 fl. ozs. per 100 gallons of water was added.

(3) Borax 1 lb., Calcium nitrate 16 lb. per 100 gallons of water applied as in 2 (a) and 2 (b).

(4) Control—unsprayed.

Boron was included as this element is known to be associated with the development of corkiness an allied condition.

Trees at Della Polina's were old trees, poor to fair vigour and carrying a heavy crop. Trees at M. C. Fry & Sons were large and vigorous and carrying a very light crop. In both instances past experience had shown pit to be severe in most years. At Fry's it has not been unusual for a high proportion of the fruit to be lost during the harvest, handling and early storage period.

SPRAYING

A satisfactory solution of the calcium nitrate was only obtained by dissolving the salt in very hot water and then adding to the spray vat. At Bridgetown two-thirds to one gallon of spray was applied per tree by means of a power spray. At Donnybrook a knapsack was used.

Some leaf scorching occurred on weak foliage sprayed with calcium nitrate in late January. Fruit injury consisting of a greenish grey tear stain mark was also noted on fruit from one tree. It is felt that this could have resulted from inadequate mixing in the spray vat.

HARVESTING AND STORAGE

A sample of 200 fruits was harvested from each tree at Bridgetown on February 24th and at Donnybrook on February 29th. The apples were sorted and a record made of tree pit. The remaining sound fruit was stored in experimental chambers at Robbs Jetty Cool Stores at 32° F. until May by which time storage pit was well developed. Assessment of pit was made after a period of one week out of cool store.

RESULTS

Unfortunately as the result of an abnormally mild winter the trial trees at Donnybrook were very late blossoming, fruit set was erratic and very light and the resultant fruit was very off type. Pit was very severe and although some improvement resulted from the sprays no commercial control was obtained. It should be noted that the last spray was January 1st. Sprays later in January may have been more effective.

The trial at Bridgetown was however, very successful. Borax gave no improvement but calcium nitrate sprays reduced total pit that is tree pit plus storage pit to almost one fifth. Fruit from unsprayed trees developed 24 per cent. pit as against 5 per cent. for the calcium nitrate treatment. The effect was, however, more spectacular than these figures indicate because of the much greater severity of pitting in individual apples in the unsprayed control. Prior to harvest sprayed trees could easily be picked out in the orchard because of the very pronounced reduction in tree pit.

Details of the variation in pit according to treatment are shown in the following table. Slight pit would include fruit showing some pitting but insufficient to prevent its sale. Severe pit would seriously reduce the commercial value of the fruit. It will be noted that practically no severe pitting occurred where calcium nitrate sprays were used.

CALCIUM NITRATE SPRAY TRIALS AT BRIDGETOWN

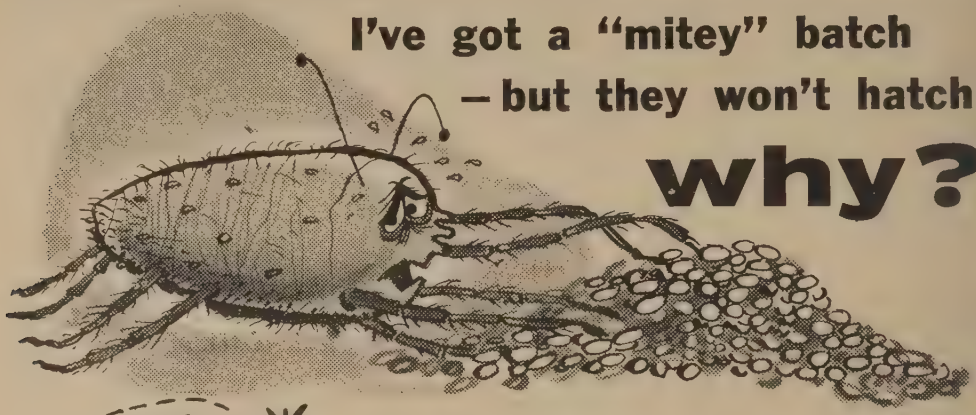
Treatment	Tree	Tree Pit at Harvest	Pit after Cool Storage		Total Fruit Pitted per 200 fruit sample	Average per cent. Pit
			Slight	Severe		
1. Borax Spray	1	8	18	14	40	
	2	12	21	22	55	
	3	3	38	7	48	
	4	23	12	21	56	
	5	24	35	22	81	28
2. Calcium Nitrate Sprays, 15th Nov., 1st Jan., 11th Jan.	1	2	4	0	6	
	2	1	6	0	7	
	3	2	6	1	9	
	4	5	17	0	22	
	5	0	3	3	6	5
3. Calcium Nitrate Sprays, 1st Jan., 11th Jan., 25th Jan.	1	0	14	1	15	
	2	6	9	0	15	
	3	2	6	0	8	
	4	1	8	0	9	
	5	3	2	0	5	5·2
4. Unsprayed	1	5	21	17	43	
	2	10	26	9	45	
	3	5	20	2	27	
	4	9	26	6	41	
	5	23	42	20	85	24·1

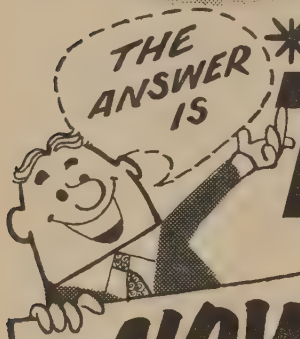
While no firm recommendation can be made at this stage it is felt that calcium nitrate sprays are worth trying on an experimental basis by anyone who has trouble with Bitter Pit in Cleos.

From all information available it would appear that at least three sprays are required and the best time would be during December and January. A suggested programme would be mid December, early and mid-late January. In view of the slight injury to leaves and fruit on odd trees it is not advisable to exceed 10 lb. of calcium nitrate per 100 gallons of water. Calcium nitrate was not available in commercial form last season but it is anticipated that supplies will be obtainable later this year.

This is the first promising lead for the control of pit and further work is planned for the coming season.

I've got a "mitey" batch — but they won't hatch why?





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ICI

LUPINOSIS IN SHEEP

LABORATORY STUDIES

By M. R. GARDINER, B.S., V.M.D., Chief Veterinary Pathologist, and
M. C. NOTTLE, M.Sc. (Agric.), Biochemist.

IN earlier articles by Bennetts (1957, 1960), the clinical and pathological features of lupinosis, as seen in field outbreaks, were described. The suggestion was made that the roughage portion of the lupin plants was responsible for the disease. More recent observations suggest a relationship between parasitism and lupinosis.

Experiments were designed to study various aspects of the problem based on these observations, and also to determine the possible role of fungi in the disease. Therefore, different parts of the lupin plant were fed to small groups of sheep. One half the sheep in each group were given a suspension of mixed parasites, considerably augmenting the natural infestations carried. In another experiment, 2 sheep groups were fed lupins which had been sterilised, sterilised and fungus inoculated, and non-sterilised and fungus-inoculated.

LUPIN-PARASITE EXPERIMENT

Fourteen sheep were used in this experiment and care was taken to procure young animals never exposed previously to lupins and which were lightly parasitised.

The lupin material fed was gathered from a property at Mooliabeenie. These lupins had caused an acute outbreak of the disease on this property and the material was, therefore, considered to be "toxic" material. It was separated into stalk, leaf, husk and seed fractions for the feeding trial. Each component, as fed to the group consuming it, was essentially uncontaminated, although there were small amounts of stalks in the leaf and husk fractions. The stalks were hammer-milled but the other fractions were not processed in any way.

The lupin sheep were group fed and brought into their diets of 500 grams lupins and 100 grams chaff per head per day, while the sheep acting as controls were fed at a calculated rate of 500 grams chaff and 100 grams oats per head per day.

The suspensions of mixed parasites were administered at the beginning of the experiment and again on the 7th and 14th days, and the effect of these drenches on parasitic burdens was assessed throughout the experiment by worm egg counts, and at termination, by a complete count of each parasitic species.

The course of this experiment was followed by regular weighings, feed consumption measurements, clinical examinations and blood studies. The sheep were killed when severely affected with lupinosis and up to about 5 weeks, if they survived this long without clinical signs. At post-mortem, a complete pathological and parasitological study was made on each animal and this was followed by a very detailed histological study of all body organs and tissues.

The consumption of all rations was poor and consequently marked losses in body weight occurred. The mean feed consumption and mean daily weight loss per sheep are shown in the following table:—

	Stalks	Leaves	Husks	Seeds	Control
Total feed/day g.	246	491	450	226	319
Lupins/day g.	112	368	336	110	....
Protein/day g.	15·0	55·7	19·2	40·8	15·9
Loss Bodyweight/lb.	0·63	0·49	0·56	0·51	0·25
Period on lupins (days)	17–18	21–33	15–31	32–33	....

In the majority of sheep the worm egg counts increased slightly in those not receiving, and strikingly in those receiving, larval suspension drenches.

There were few clinical manifestations of lupinosis during this experiment in the sheep fed the leaves and husks, except for loss of weight. The sheep fed lupin seeds and the control sheep all showed a decline in appetite towards the end which was thought to be due to cobalt or Vitamin B12 deficiency in the rations offered. It was found that both the maintenance laboratory ration and the lupin seeds were markedly deficient in cobalt.

In contrast to the sheep in the above groups, those fed lupin stalks developed listlessness and apathy, followed quickly by severe jaundice deepening rapidly from the 14th to 17 days. Both clinically and pathologically these sheep closely resembled sheep undergoing the haemolytic crisis of copper poisoning.

A battery of biochemical tests was used in the trial, as measurements of liver and kidney functions and as indicators of the progress of the disease.

It has been stated above that the sheep fed the lupin stalks were the only ones developing clinical lupinosis, and that by the 17th day they were so severely affected that they were killed. Nevertheless, the sheep fed lupin leaves developed definite pathological, as distinct from clinical, signs of lupinosis in 21 to 33 days. Only by biochemical and histological criteria could leaf-induced disease be recognised, although in a couple of sheep, an experienced observer might have detected early gross liver changes.

There was little evidence of lupinosis in the sheep fed the husk material although our pathological studies indicated that extremely early changes of the disease were occurring in these livers also.

There was a definite tendency for the development of high liver copper in the sheep fed the lupin leaves and stalks, and for a decline in liver cobalt or liver Vitamin B12 in the experimentally parasitised sheep.

It is interesting that no other organ systems appeared to be affected primarily by the lupins. In particular, the kidney was entirely normal in all sheep. However, there was some evidence of a secondary, probably nutritional, effect on the bone marrow, manifested by a cellular inactivity (hypoplasia), and on the red blood cell. It is not intended to go into the detailed biochemical, haematological or pathological aspects of the experimental disease in this article.

There were clear indications that the onset of parasitism, especially infestations with *Haemonchus contortus* (Barber's pole worm), increased the severity of the liver damage, and accelerated the disease process. Further evidence supporting this contention is given in the article *Field Studies on Lupinosis*.

A study now under way at the Animal Health Laboratory is testing the influence of various deficiencies on the development of Lupinosis. Sufficient work has been done on the Lupinosis problem to indicate the tremendous complexity of the disease and the bewildering variety of factors involved. It would appear that the interplay of these factors including, perhaps some inherent toxic principle in lupin plants, determines the onset and eventual form of the disease in field outbreaks.

LUPIN-FUNGUS EXPERIMENT

From time to time the suggestion has been made that fungi growing on the lupin plant are responsible for lupinosis. An experiment designed to answer this question has been conducted at the Animal Health Laboratory, and has succeeded in giving at least a partial answer.

Small groups of sheep were fed sterilised, sterilised and fungus-inoculated, and non-sterilised and fungus-inoculated lupins for 41 days. The lupin material consisted of a mixture of husks (75%), stalks (7%), leaves (7%) and seeds (11%), and was gathered in the metropolitan area. It had not been associated with any clinical disease in sheep. The fungi employed in this study were isolated from "toxic" lupins from a lupinosis property, cultured in the laboratory and sprayed on to the lupin material.

The lupins were well supplemented with chaff or oats or both. The sheep used in this experiment were young, healthy animals, not previously grazed on lupins, and only slightly parasitised.

Detailed pathological studies were carried out in this series in the manner described above in the lupin-parasite experiment. Although a few early changes

were detected in the livers of most of these sheep, sufficient to indicate the presence of a "lupinosis factor" in the material fed, none of the typical lesions of the disease developed in any animal regardless of the treatment used in preparing the lupins. As in the previous study, liver coppers were high in all the sheep, and in several extended into the "toxic" range, i.e., above 1,000 p.p.m. but, in contrast to the lupin—parasite experimental results, liver cobalts remained in the high normal range. This may have been due to the fact that the rations fed to the sheep were supplemented with cobalt.

Although this experiment did not rule out the possibility of a fungus being involved in the development of the disease, it did show that the fungal species used were not active in inducing lupinosis under the conditions of the trial.

ACKNOWLEDGMENTS

It is with much pleasure that the contributions to these studies of the following persons are acknowledged:—

Dr. I. W. Parnell and Mr. Victor Bamford for parasitological work.

Mr. Alan Beck, C.S.I.R.O. for copper and cobalt determinations.

Dr. W. R. Pitney of the Royal Perth Hospital for Vitamin B12.

Mr. B. Sharp and Miss H. Buchan for histological preparations.

Mr. Cass-Smith for aspects of the fungus study and to Mr. C. Easter and Mr. H. Masters for haematology and blood chemistry.

Also our thanks are given to the members of the Dandaragan and Gingin Pasture Improvement Groups for their enthusiastic help in gathering the lupins, thus making these studies possible, and to Mr. L. O. C. Thompson, Mooliabeenie, on whose property the actual lupins used in the experiments were grown.

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FIELD STUDIES

By M. R. GARDINER, B.S., V.M.D., Chief Veterinary Pathologist, and
A. W. WILLIAMS, B.V.Sc., Veterinary Officer, Geraldton

TO complement the laboratory studies reported in a companion paper, a field study was set up on a property where severe outbreaks of lupinosis had occurred for several years. Mr. Eric Smart, of "Erregulla Springs," Mingenew, placed the necessary sheep at our disposal and provided the paddocks and labour essential for the conduct of the trial. We wish to extend to Mr. Smart our thanks for his co-operation and aid.

This trial had two main objectives:—

(1) To study the development and progress of a typical field outbreak of lupinosis, and evaluate the factors associated with the toxigenesis.

(2) To assess the effect of alternative feeding on the course of lupinosis.

A mob of 100 healthy weaners, not previously exposed to lupins, was divided into 2 groups of 50 sheep each. One of these groups grazed for 1 week on the "toxic" lupin paddock followed by one week on a non-lupin paddock. The second group was grazed on the "toxic" lupins for a fortnight and then spelled for 3 days on the non-lupin grazing.

Both groups were carried through an entire summer grazing period, from early January to late May, on their respective feeding cycles.

Each fortnight one sheep from each group was shipped to the Animal Health

Laboratory for a complete pathological and parasitological examination, exactly comparable to that discussed in the paper on "Laboratory studies on lupinosis." Ecological data such as rainfall, temperature, feed availability and so forth were collected throughout the trial. The alternative feed in the non-lupin paddock consisted of (approximately) Flatweed 26 per cent., sub-clover 24 per cent., Wimmera rye 28 per cent., Brome grass 10 per cent. other species 12 per cent.

Lupin material and alternative feed were subjected to standard feed analyses at the Government Chemical Laboratories. The chief points of interest in these feed analyses were the high crude protein content of the lupin seeds; low phosphorous values for the lupin leaves and stalks; low copper values for all the feeds available, both lupin and non-lupin; and very low cobalt values for the lupin seeds and lupin roughage.

RESULTS

The following facts have emerged from this study:—

(1) There was no significant difference in the development and progress of lupinosis with respect to time on alternative feeding. That is, the sheep on 50 per cent. lupin-50 per cent. alternative feeding were as quickly and as severely affected as those on 82 per cent. lupin feeding.

(2) The early changes of lupinosis, designated as a mild subacute lupinosis, were apparent by pathological criteria from the earliest days of the trial; that is, the two sheep examined after two weeks on their respective grazing regimens, were in no essential way different from those at the eighth week. It was quite clear, therefore that from the beginning the lupinosis "factor" was present and causing subclinical damage. There were few changes visible in the livers of these early sheep on gross inspection, and it was necessary to judge the lupin effect on the basis of pathological and biochemical observations.

(3) Towards the end of March there was a marked exacerbation of lupin damage in the sheep from both groups, and from this time onwards liver damage was obvious on gross inspection, as well as by laboratory criteria.

(4) The relevant events concurrent with this rapid progression of the disease in the second half of March were an increase in rainfall and a definite increase in parasitism. Especially noticeable was the appearance of infestation by the Barbers' pole worm (*Haemonchus contortus*). This worm was entirely absent in the parasitological spectrum during the first two months, thereafter quickly gaining the dominant position among the various parasite species found in the abomasum and intestines.

(5) The liver changes were followed closely by a general deterioration in the condition of the sheep on both feeding regimens, characterised by steady loss of weight and ill-thriftiness.

(6) There was an increasing disturbance in both copper and cobalt metabolism, with an elevation of liver copper and a fall of liver cobalt or Vitamin B12 in the sheep examined.

(7) In May there were definite indications of a reversal of the pathological picture of which the most prominent sign was active regeneration of liver cells. This was due probably to the availability of new green feed at this time.

(8) Although many sheep had reached the point of no return as far as liver damage was concerned, it is probable that those animals showing a minimum of fibrotic and cirrhotic changes would have made satisfactory recoveries provided adequate nutrition were available.

(9) Lupinosis would appear to be a toxic nutritional cirrhosis.

Testing in Australia

By G. H. VASEY, B.C.E., A.M.I.E. Aust., Officer-in-Charge of Tractor Testing, and W. F. BAILLIE, Dip. Mech. Eng., Dip. Elec. Eng., Testing Officer, University of Melbourne

AUSTRALIA is one of several countries that have set up "official" tractor testing schemes. These schemes mean testing stations that, while providing a testing service for both the manufacturing industry and the consumer, in effect mainly the farming industries, are independent of either.

Unless the tests are compulsory, as at Nebraska, they are better described as "formal" rather than "official." The following paper sets out the origins and scope of formal testing of tractors, particularly in Australia. A second paper describes the test procedure.

ORIGINS OF TESTING SCHEMES—NEBRASKA, 1919

The origin of all the present tractor testing schemes can be traced back to the "Nebraska tests" of the U.S.A.

In 1919, the legislature of the State of Nebraska passed a law requiring anyone wishing to market a tractor in that State to have a sample stock model tested by the University of Nebraska; the Act also required that the test report be published.

The primary object was, simply, to provide a check against the extravagant advertising claims and correspondingly poor tractors being made by some makers who were cashing in on the new wonder —the "iron horse"—after World War I had shown these machines to be possible.

It will be recalled that the tractor only began to make its appearance in the years immediately following the war; many wildcat companies entered the field with little or no experience to back their products; many hopeless designs were put on the market. Farmers, of course, had no way of assessing these machines, whether the claims made for them were valid or outrageous.

The Nebraska tractor test law was designed to cope with this situation. The law soon effectively covered the whole of the U.S.A. since a manufacturer could not risk the obvious implication of selling everywhere but in Nebraska!

As time went by the bad were sorted from the good; the reputable makers were quick to see the advantage of being able to base their advertising on an attested report from an independent authority with the high standing of the University of Nebraska.

More than 700 separate makes and models have passed through the Nebraska tests since 1919. Although field-day tests of tractors had been organised in England in the early twenties and thirties, and indeed at Werribee in Victoria in 1918, it is obvious that the Nebraska law and the Nebraska test scheme effectively started the notion of tested and certified tractors.

AUSTRALIAN SCHEME LAUNCHED

Until World War II, most of the tractors used in Australia were imported from the

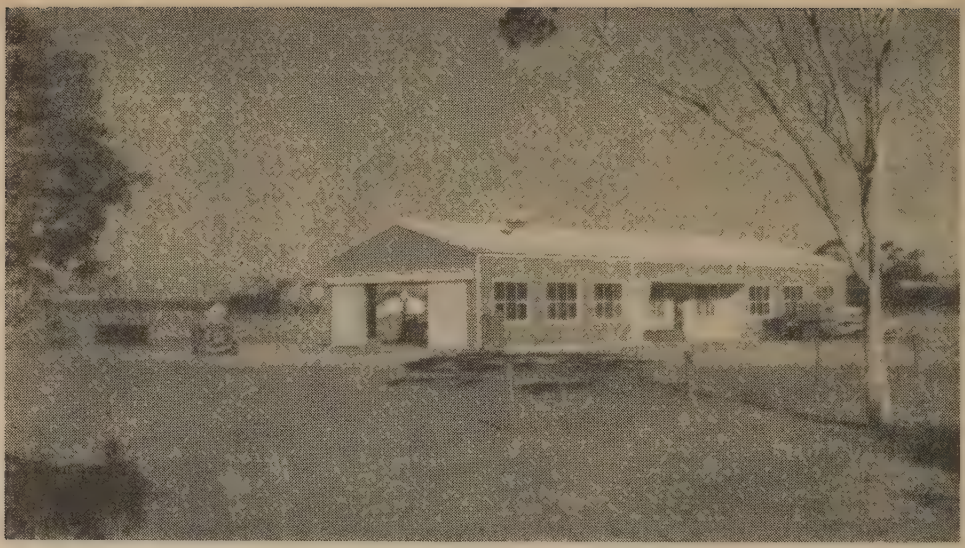

Fig. 1—The Tractor Testing Station, Werribee, Victoria

U.S.A., and so were in effect certified by the Nebraska test—for those who cared to read or use the certificate. But in the expansion of mechanised farming after the war, many tractors came to Australia from Great Britain and Europe unaccompanied by a test certificate.

Furthermore, even with the tested American models the amount of Australian content going into their assembly here was increasing, so that overseas tests were not always strictly applicable.

Besides these, some interest was being shown in the design and manufacture of tractors in Australia—Chamberlain being the notable example.

Taking all these factors into account, the Commonwealth Government sought to strengthen the interests of Australian farmers, and to provide itself with proper bases for such fiscal matters as duty and bounty, by setting up a tractor testing scheme in Australia broadly along the lines of the Nebraska tests.

At first the work was entrusted to the Aeronautical Research Laboratories of the C.S.I.R. at Fisherman's Bend. Using test procedures exactly the same as those at Nebraska, the Aeronautical Laboratories tested 23 tractors between 1946 and 1951. But, as a result of departmental changes in the laboratories, the scheme was abandoned in 1951, and reconstituted on a new basis in 1954.

COMMONWEALTH-STATES CO-OPERATION

A scheme was worked out by the Commonwealth and State Governments, through the Australian Agricultural Council, that called for co-operation between the several Governments and the University of Melbourne (in the early stages the Bureau of Sugar Experiment Stations acted instead of the State of Queensland). Under the terms of this agreement, the Commonwealth was to meet half the cost, the States the other half (in proportion to their tractor population), while the professional services were to be provided by the University.

Among the conditions laid down by the University for its participation in the scheme was that it should have full discretion in all technical matters, and that its officers appointed to carry out the tests would not only be permitted, but should be expected to carry on research work on tractors and related matters.

The scheme was to be a voluntary one, as it is in England, and for that matter, in most other testing stations. That is to

say a testing service was set up: the companies would use it, and submit tractors for test, if they saw merit or advantage in it.

At the same time the scheme was expected to recoup some of its expenses by charging test fees (the Nebraska scheme runs itself on its income from test fees, which are substantial).

These principles having been laid down, the Tractor Testing Committee* was formed comprising an officer of the Commonwealth Department of Primary Industry as Chairman, an officer of the Victorian Department of Agriculture representing the interests of all the States, and an officer of the University of Melbourne.

The first tests were done in makeshift premises at Fisherman's Bend and the State Research Farm Werribee, starting in 1954. By 1957 a Testing Station was built on the property of the Research Farm. In all, some ten models of tractor have been tested, over 20 spark arresters, and a variety of other engines and tractor equipment.

Meanwhile, the test procedures themselves have under-gone some changes, so that today the Australian test system is in some ways ahead of its colleagues overseas.

* The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne, C.1., Victoria.

NATURE OF THE TESTS

It will be appreciated that the formal testing of tractors is in no sense a competition between rival makes; it is not a question of testing this model of tractor against that, but a measuring the performance of the given tractor in a standard manner.

Nor is there any law, regulation, rule, or industrial standard that says a tractor shall have this much power, or pull, or speed, or fuel consumption. The only limitations imposed on the tractor, the only standards to be reached, are those imposed by its own instruction book, and the claims made for it.

Each tractor under test goes through a certain standard set of procedures and inspections, that amount in the end to a measurement of the tractor and its performance and qualities.

The test procedures are described in the second article of this series. Briefly, they consist of, (a) a survey of the physical properties of the tractor, (b) the power capacity of the engine and of the p.t.o. and belt outlets, (c) the power in the drawbar in the several gears, and (d) observa-

Fig. 2—Tractor under drawbar test

tion of the tractor under test and detailed inspection afterwards.

The testing procedure eliminates as far as possible matters of opinion; it concentrates attention on those things that can be measured. On some things, e.g., comfort, the opinion of the testing officers may for the time being play a part, but engineering studies are slowly reducing the guesswork even in these fields.

Although the tests conducted at other centres permit and, in effect, expect the companies to submit a selected and prepared sample tractor for test, the objective in the Australian test is to work on a sample of the stock model that has been taken at random from the run of production or stock. Such a tractor is presumed to be representative of all the tractors of that make and model currently being offered for sale, such as any buyer might buy.

REPORT OF TEST: TEST CERTIFICATE

The full technical report of the test, in its several sections, attempts to describe the tractor and its response to the checks, measures and tests put on it, and to describe them in such a way that the information is complete in itself, with no loose ends that are doubtful or uncertain.

For example, as the British test code says, no drawbar results can have any meaning unless they are clearly related to the weight of the tractor in the tests, not only total weight, but front and rear axle weights also, and for that matter the height of the drawbar.

Likewise it is not sensible to give any power values for the engine without naming each time the engine speed.

For these reasons, and so that the company's and other technical officers, including extension officers and research workers, can get full sense out of the results, the reports are at some length and in some detail. For the farmer, the physical properties and the summary of results may be sufficient.

On the power tests, the report gives a table of results for full power on the engine, the p.t.o., the belt, and the drawbar. For the rest, including the intermediate values, the story is told in two series of graphs, one set for the engine itself as the source of power, and another set for the drawbar tests.

From these, any professional reader will get a complete picture of the tractor's total performance; from them he can make what comparisons and judgments he pleases.

The last section of the report is devoted to a fairly thorough specification of the main features of the tractor, the statement being supplied by the manufacturer. Nevertheless, the testing officers will have checked most of these details (at any rate

Fig. 3—Portion of the bitumen test track

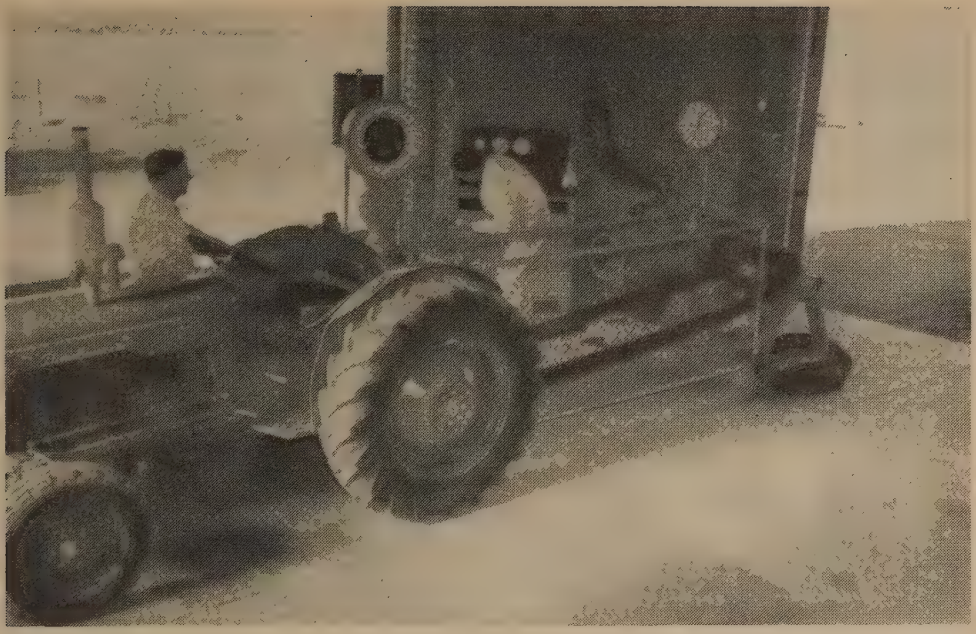

Fig. 4—Tractor under belt test

those that are observable from the outside) because, of all people, the testing officers must be sure that the tractor they have tested is the tractor described in the specification.

For the farmer reader the report is also issued in a shortened form, with all the description as it affects the operation of the tractor, and with a useful summary of the results, but with much less tabular and graphical detail.

Whereas some hundreds of the Technical Report are issued to trade, professional and overseas bodies, some thousands of the Farmers' Edition are distributed for issue to farmers, if they want them, all over Australia.

A tractor that has gone through the tests, and for which a report has been issued, may well be called a certified tractor. To bring this point home, to both users and prospective users of the tractor, a certificate is issued to the company saying that a stock model of this tractor has been tested, quoting the test number and the date, over the testing officer's signatures.

This certificate is in the form of a transfer to be affixed to every tractor of the model in stock, so that the certificate may fairly be said to be attached to the tractor.

INTERPRETATION OF TEST

There is no difficulty in interpreting the results on the engine: there is its full power output that drives everything else in the tractor; there are its torque and fuel consumption, at all speeds and loads, especially of course maximum power at the defined rated speed.

Likewise there is no difficulty about p.t.o. and belt power values; the tests show what the user can expect on p.t.o. drive and on belt drive from a typical tractor of this model; not that a difference of 2 or 3 h.p. one way or the other makes a lot of difference; no user is able, except rarely, to say what power he wants precisely for this job or that.

The physical properties of the tractor are described, and that is all there is to that: heights, lengths, weights, turning circles, p.t.o. and belt speeds, instruments and controls. They may suit him, or they

may not, but there is not much room for argument about them.

It is only when we come to the drawbar tests and to the question "What will this tractor do on my paddock, with my cultivator?" that difficulties of interpretation arise.

The difficulties are threefold:—

(a) as a rule no one knows what pull is required to work that plough, or any other machine;

(b) no one can say how the tractor will perform on surfaces other than the test track;

(c) both the pull required to work the plough, and the performance of the tractor's wheels will vary from soil to soil and, even on the one paddock, with the day to day and seasonal variations in the soil.

It is a matter for regret that a lot more is not known about the pull, and the p.t.o. power in some machines, required to work the different classes and makes of machine on the different types of soil, or even on a standard soil, if there was such a thing.

It will be a very long time indeed before the soil engineers will be able to relate machine and tractor performance, even on the one soil type, to the differing conditions that can arise in a given soil: differences in the states of tilth (from pasture, through stubble, to rough cultivated land), and differences in the moisture conditions of the soil.

As to (b), one can say that, compared with the hard dry test track, a tractor in the field will deliver less pull, and will suffer more slip, and so will run at slower speed, and deliver perhaps a lot less power, even though the engine may be fully loaded. As the soil conditions get looser, rougher and/or wetter the difference between test performance and field performance gets worse.

It is perhaps possible to say that, for tractors of comparable weight and power capacities, the field performances are likely to be as much alike as the test performances are, but at some undecidable lower value.

It is hoped that, in due course, even this awkward question can be answered: but the answer is not yet in sight.

(To be continued.)

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BOOKS... *for FARMERS*

THE following books on agriculture, recently published and obtainable to order from most booksellers, have been added to the stock of the Library Board of W.A. and may be borrowed freely from any public library associated with the Board, or consulted at the State Library of Western Australia.

GENERAL

THE AUSTRALIAN ENVIRONMENT; Issued by the Commonwealth Scientific and Industrial Research Organisation. 3rd Ed. (Rev). Melb., 1960.

FARM TRAILERS, WAGONS AND RACKS [by W. Kalbfleisch and others]; published by the Research Branch of the Canadian Department of Agriculture. Rev. Ed. Ottawa, 1959.

AN INDIAN EXPERIMENT IN FARM RADIO FORUMS; by J. C. Mathur, and P. Neurath. Paris, 1959.

LITERATURE OF AGRICULTURAL RESEARCH; by J. R. Blanchard and H. Ostvold. Berkeley (Calif.), 1958.

POLYTHENE FILM IN HORTICULTURE; by H. R. Spice. Lond., 1959.

SOLAR ENERGY; by F. M. Branley. English Edition Edited by E. Larsen. Lond. 1959.

CROP MANAGEMENT

PLANT PROPAGATION IN PICTURES: How to increase the number of plants in your home and garden by division, grafting, layering, cuttings, bulbs and tubers, sowing seeds and spores; by M. Free. Lond., 1957.

SOILS AND FERTILISERS

SOIL CONSERVATION; by H. Kohnke and A. R. Bertrand. N.Y., 1959.

DISEASES AND PESTS

DISEASES OF FARM CROPS; by A. Beaumont. Lond., 1959.

WEEDS; compiled by J. N. Whittet; published by the New South Wales Department of Agriculture. [Syd., 1958.]

FIELD CROPS

PRODUCTION OF FIELD CROPS: A textbook of Agronomy; by T. K. Wolfe and M. S. Kipps. 5th Ed. N.Y., 1959.

FRUIT GROWING

APPLE GROWING IN NEW SOUTH WALES; by H. Broadfoot and E. C. Whittaker; published by the New South Wales Department of Agriculture. Syd. [1956.]

BANANAS; by N. W. Simmonds. Lond., 1959.

BUSH FRUITS; [Being] Bulletin No. 4 of the Ministry of Agriculture, Fisheries and Food. 7th Ed. Lond., 1958.

THE CIDER FACTORY: Plant and layout; issued by the Rural Engineering Service of the French Ministry of Agriculture, Translation and diagrams prepared by V. L. S. Charley [and others]. Lond., 1953.

RE-WORKING APPLE AND PEAR TREES; by J. A. Ballantyne and E. C. Whittaker; published by the New South Wales Department of Agriculture. Syd. [1956.]

STRAWBERRIES; [Being] Bulletin No. 95 of the Ministry of Agriculture, Fisheries and Food. 6th Ed. Lond., 1958.

VARIETIES OF FRUIT TREES, BERRY FRUITS AND VINES IN AUSTRALIA; by R. Pengelly; issued by the Division of Plant Quarantine, Commonwealth Department of Health. Canb., 1957.

LIVESTOCK

BEEF CATTLE HUSBANDRY; by A. Fraser. 2nd Rev. Ed. Lond., 1959.

AN INTRODUCTION TO ANIMAL HUSBANDRY IN THE TROPICS; by G. Williamson and W. J. A. Payne. Lond., 1959.

KNOW YOUR HORSE: A Guide to Selection and Care in Health and Disease; by W. S. Codrington. New Rev. Ed. Lond., 1958.

THE MERINO, PAST, PRESENT AND PROBABLE; by H. B. Austin. 2nd Ed. Syd., 1944.

RED POLL NOTES ON TYPE, STANDARDS, MILK AND BEEF; issued by the Red Poll Cattle Breeders Association of Australia. [Melb., 1959?].

THE STORY OF WOOL GROWING IN NEW ZEALAND: Lecture [given] at the Royal Society of Arts, London on Tuesday, 17th March, 1959, by J. S. Duncan; issued by the Department of Education of the International Wool Secretariat. Lond. [1959?].

SYSTEMATIC STOCK JUDGING INSTRUCTION; by D. C. Bower. [Lond., 1959.]

THE WORK STUDY GUIDE TO SILAGE MAKING; issued by Imperial Chemical Industries Limited. (Central Agricultural Control). Lond. [1959.]

POULTRY

METHODS OF INTENSIVE POULTRY MANAGEMENT; by R. Feltwell; [Being] Bulletin No. 152 of the Ministry of Agriculture, Fisheries and Food. 2nd Ed. Lond., 1958.

PROFITABLE POULTRY MANAGEMENT; by J. M Snyder [and others]. 23rd Ed. Cayuga (N.Y.), 1958.

TABLE CHICKENS; [Being] Bulletin No. 168 of the Ministry of Agriculture, Fisheries and Food. Lond., 1958.

DAIRYING

DAIRY CATTLE JUDGING TECHNIQUES; by G. W. Trimberger. Englewood Cliffs (N.J.), 1958.

BEE-KEEPING

BEE-KEEPING IN ANTIQUITY; by H. M. Fraser. 2nd Ed. Lond., 1951.

HISTORY OF BEE-KEEPING IN BRITAIN; by H. M. Fraser. Lond., 1958.

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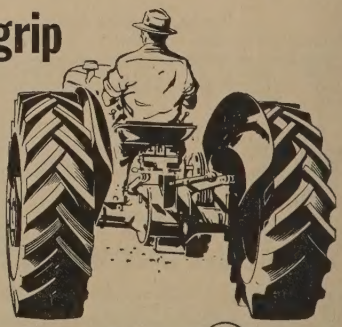

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SPARK ARRESTER TESTS

TEST No. SPA-10 STOCK MODEL, JULY 1958

SPARK ARRESTER FOR INTERNATIONAL AW-7

Tested for International Harvester Co. of Australia, Geelong

FORMAL tests on spark arresters are conducted by The Tractor Testing Committee* at the Testing Station, Werribee, on behalf of those Companies concerned with tractors, engines or spark arresters who wish to have these equipments tested. The arrester is tested on the engine it is specially designed for (as in this instance), or if it is sold for use on any or several engines, it is tested on an engine of the highest power for which the spark arrester is intended.

1. Test Procedure.

The method of test is based on a procedure standardised by the Society of of Automotive Engineers (U.S.A.). This consists of feeding a weighed quantity of carbon particles of given size into the exhaust of the working engine, and then catching in a trap, and weighing, the particles that the arrester allows to pass through. Separate runs are conducted with particles of larger and smaller size; in some runs the engine is working at full load, in others at fast idle under no load.

According to the S.A.E. standard, no particles of the larger size should escape the arrester, and not more than 10 per cent. of the smaller size. At the same time the extra back pressure imposed on the exhaust system by the presence of the arrester should be no more than 10 inches in a water barometer.

2. Name and Type of Arrester.

"AW-7" (I.H.C. Part No. 843846R91).

Submitted by: International Harvester Co. of Australia Pty. Ltd., Geelong, Victoria.

For Particular Tractor: International AW-7 Diesel.

3. Brief Specification of Arrester.

Operating Principle: Perforated screen.

Declared Maximum Horse-Power: Not stated (nominally 50 shaft h.p.).

Dimensions: Exhaust pipe: dia.—2⅜"; Tail pipe: dia.—2½", length—5¼". Arrester: outside dia.—5¼", length—9½", weight—6½ lb.

Materials: Mainly 16-gauge steel. Screen —26 gauge perforated stainless steel.

Mounting: Vertical, ahead of operator, effluent upwards.

Details of Test Engine: International AW-7 Tractor. 4-cyl. diesel 47 belt horsepower maximum; 264 cubic inches; rated speed, 1,450 r.p.m.

4. Summary of Test Results.

(Particles injected at rate of 100 gms. in 18-20 minutes.)

* The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne.

(*a*) *Effectiveness of Spark Arresting*:—

Particle Size	Engine Load Condition	Carbon Passing Arrester (Percentage)	Remarks
Large	High	*Nil*	Two tests
Large	Low	*Nil*	Two tests
Small	High	1·0	Average of two tests
Small	Low	0·5	Average of two tests

(*b*) *Back Pressure:* At High Load, 4½ inches water.

(*c*) *Temperatures:* Not taken.

(*d*) *Noise Levels:* Not taken.

5. Comment.

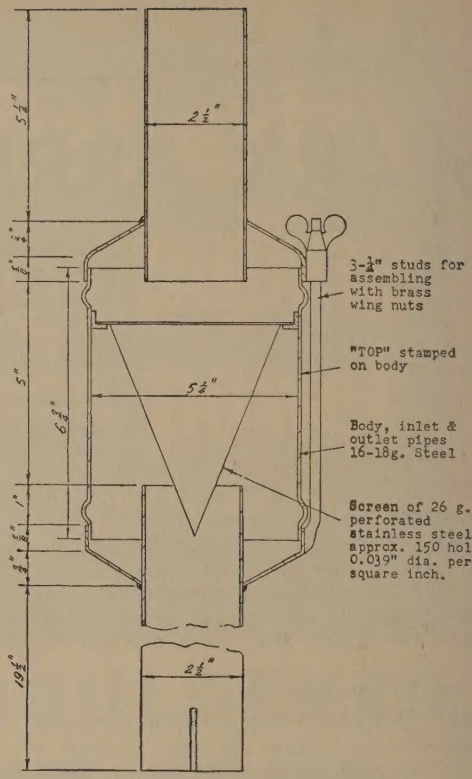
(*a*) *Risk of Bad Fitting through Damage:* The two sheet-metal ends fit over the sheet-metal shell: if the fitting at the lower (inlet) end is imperfect, e.g., through denting by damage, then unscreened carbon particles could escape.

(*b*) *Screen Openings and Material*: The screen consists of perforated 26-gauge stainless-steel sheet. Overseas tests suggest that burning of carbon particles which may become caught in the screen leads to rapid failure unless the screen is made of nickel chromium alloys.

Compared with iron-wire screens, the use of stainless steel in the form of perforated sheet would be expected to give a longer life.

(*c*) *Prospective Life*: It is impossible to estimate the probable life of the screen; it is, however, easily replaced, and the makers expect it to be regularly inspected, and to be renewed as required.

Subsequent tests for 1,000 hours at full load, reported by the applicant company, suggest that the stainless-steel screen is virtually unimpaired after such service, and that it is likely to outlast the shell.



International AW-7 Spark Arrester.
A.T T M SPA-10, July 1958.

Note.—This report makes no promise about the likely performance of the arrester other than in the condition supplied for test. i.e., new.

University of Melbourne, 1st August, 1958.

W. F. Baillie,
Testing Officer.

G. H. Vasey,
Officer-in-Charge,
Tractor Testing.

FARMERS

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